55-1520-235-MTF

TM 55-1520-235-MTF

# MAINTENANCE TEST FLIGHT MANUAL

# ARMY MODEL OH-58C HELICOPTER

This copy is a reprint which includes current pages from Changes 1 and 2.

**HEADQUARTERS**
**DEPARTMENT OF THE ARMY**

**1 MARCH 1982**

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TM 55-1520-235-MTF

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *1 March 1982*

**TM 55-1520-235-MTF is published for the use of all concerned.**

**By Order of the Secretary of the Army:**

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*General, United States Army*
*Chief of Staff*

**Official:**

ROBERT M. JOYCE
*Brigadier General, United States Army*
*The Adjutant General*

DISTRIBUTION:
To be distributed in accordance with DA Form 12-31, five copies to each account, Operator Requirements for OH-58C aircraft.

# URGENT

TM 55-1520-235-MTF
C 2

CHANGE NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 5 September 1986

Maintenance Test
Flight Manual

ARMY MODEL
OH-58C HELICOPTER

TM 55-1520-235-MTF, 1 March 1982, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

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| 2-25 and 2-26 | 2-25 and 2-26 |
| - - - | 2-26.2/2-26.2 |
| 2-31 and 2-32 | 2-31 and 2-32 |
| - - - | 2-32.1/2-32.2 |

2. Retain these pages in front of manual for reference purposes.

NOTE

Laminated pages will be provided in next normal change.

# URGENT

TM 55-1520-235-MTF
C 2

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DISTRIBUTION:
To be distributed in accordnace with DA Form 12-31, MTF Maintenance requirements for OH-58C Helicopter, Observation.

TM 55-1520-235-MTF
C 1

CHANGE NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 30 December 1983

Maintenance Test
Flight Manual

ARMY MODEL
OH-58C HELICOPTER

TM 55-1520-235-MTF, 1 March 1982, is changed as follows:

1. Remove and insert pages as indicated below.

| Remove pages | Insert pages |
|---|---|
| 2-3 and 2-4 | 2-3 and 2-4 |
| 2-7 thru 2-12 | 2-7 thru 2-12 |
| 2-19 thru 2-26 | 2-19 thru 2-26 |
| 2-33 thru 2-36 | 2-33 thru 2-36 |
| 3-1 thru 3-4 | 3-1 thru 3-4 |
| 3-23 and 3-24 | 3-23 and 3-24 |

3. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

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TM 55-1520-235-MTF
C 1

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**JOHN A. WICKHAM, JR.**
***General, United States Army***
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**Official:**

**ROBERT M. JOYCE**
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***The Adjutant General***

DISTRIBUTION:
To be distributed in accordance with DA Form 12-31, five copies to each account, Operator Maintenance Requirements for OH-58C aircraft.

**WARNING**

A maintenance test flight is an exceptionally demanding operation and requires a thorough flight readiness inspection (preflight). The flight readiness inspection is prescribed in TM 55-1520-235-10 Operator's Manual and must be completed prior to each maintenance test flight. Emergency procedures are found in the applicable -10 or checklist and are not duplicated in this publication. Prior to each maintenance test flight, the pilot will contact maintenance/quality control personnel to determine the maintenance that has been performed. This manual should be used only by qualified maintenance test flight pilots as required in AR 95-1.

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## REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 lcoated in the back of the applicable Aircraft Operator's Manual (when using the 2028-2 from the Operator's manual, insure the publication number and title reflect this MTF) direct to Commander, US Army Troop Support and Aviation Materiel Readiness Command, ATTN: DRSTS-MPSD, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished to you.

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# SECTION I. INTRODUCTION

1. **Purpose.** The purpose of this manual is to provide complete instructions for performing a maintenance test flight of OH-58C aircraft. For the specific conditions which require a general or limited maintenance test flight, refer to TM 55-1500-328-25 and TM 55-1520-228-23-1/2.

2. **Definition.**

*a. **Maintenance Test Flight.*** A functional test flight for which the primary purpose is to determine whether the airframe, power plant, accessories and other equipment are functioning in accordance with predetermined requirements while subjected to the intended environment.

*b. **Warnings, Cautions, and Notes.*** Warnings, Cautions, and Notes are used to emphasize important and critical instructions and are used for the following conditions:

**WARNING**

**An operating procedure, practice, etc., which, if not correctly followed, will result in personnel injury or loss of life.**

**CAUTION**

**An operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.**

NOTE

**An operating procedure, condition, etc., which is essential to highlight.**

**3. General Information.**

*a.* This manual covers only maintenance test flight of OH-58C aircraft and in no way supersedes any information contained in TM 55-1520-235-10 or -CL, but is to be used in conjunction with the -10 and -CL. For the purpose of maintenance test flights only, this manual satisfies all the requirements of the -CL from "Before Starting Engine Checks" through "Engine Shutdown Checks."

*b.* Crew requirements will be as specified in TM 55-1500-328-25 and TM 55-1520-235-10.

*c.* The duration of the general or limited test flight will be in accordance with the requirements of TM 55-1500-328-25.

**4. Special Instructions.**

*a. Cargo and Passengers.* Cargo and passengers are prohibited on maintenance test flights.

*b. Forms and Records.* Forms and records will be checked prior to the maintenance test flight to determine maintenance performed and type of test flight required (i.e., general or limited).

*c. Configuration.* The configuration of the aircraft should be determined prior to the maintenance test flight in order to determine performance parameters.

*d. Post Test Flight Inspection.* A thorough visual inspection will be performed to the extent necessary to assure that deficiencies or shortcomings developed as a result of the maintenance test flight are detected.

*e. References.* When a maintenance test flight is required to assure proper operation of a specific system(s), refer to the applicable maintenance manual for the limits of that system.

*f. Asterisked Checks.* An asterisk (*) prior to a check requires that the Test Flight Check sheet be annotated with a specific reading. Also a check (√) for satisfactory performance, or an (X) for problem detected will be recorded and a short statement entered in the "remarks" block of the check sheet.

*g. Maintenance Test Flight Check Sheet.* The sample check sheet contained in Section V will be used for all test flights. When a test flight is performed for the purpose of determining if specific equipment or systems are operating properly, completion of only that portion of the maintenance test flight check sheet applicable to the specific equipment or systems being tested is required. The aircraft test flight check sheets may be locally reproduced. Continuation sheets may be used when necessary. Items that prove to be unsatisfactory during the test flight, and require corrective action, shall be listed in the remarks block during flight and transferred to DA Form 2408-13 immediately after termination of the flight. The sheet will be attached to DA Form 2408-13 immediately after termination of the flight. The sheet will be attached to DA Form 2408-13 upon completion. After accumulation of two or more sheets, the data should be reviewed to determine if trends are developing.

## SECTION II. MAINTENANCE TEST FLIGHT CHECKLIST

**General.** This section contains the maintenance test flight requirements peculiar to Army model OH-58C aircraft. Conditions requiring accomplishment of test flights shall be in accordance with TM 55-1500-328-25. The requirements contained herein are established to assure a thorough inspection of the aircraft before flight, during flight and upon completion of the maintenance test flight. The right side of the checklist (Troubleshooting Reference) is cross-indexed to the troubleshooting guides contained in Section III. A dash between references means "through;" a comma means "and." The references list the possible abnormal conditions, indications or malfunctions which could be encountered while performing the procedure.

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|
| **PRIOR TO MAINTENANCE TEST FLIGHT** | |
| *1. Forms and Records - Check. | |
| *2. A thorough flight readiness inspection will be performed in accordance with the requirements contained in TM 55-1520-235-10. | |
| 3. Special preflight checks - Accomplished. | |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

## BEFORE STARTING ENGINE CHECKS

| | | |
|---|---|---|
| 1. | Crew door and armor - Secure. | |
| 2. | Emergency jettison handle - Check handles safetied with 0.020 copper break-away wire. | |
| 3. | Pedals - Adjust pedals as required. | |
| 4. | Seatbelts and Shoulder Harness - Fasten and tighten. | |
| 5. | Shoulder Harness Locks - Check operation and leave unlocked. | |
| 6. | Cyclic control - Friction off, check freedom of movement through full range of travel (note main rotor pitch change). | H1, 12 15 |
| 7. | Collective control - Friction off, check freedom of movement through full range of travel (note main rotor pitch change and coupling effect). | H6, 7 |
| 8. | Pedals - Check pedals through full range of travel. | H3, 4 |
| 9. | Throttle - Full open, close to idle stop, check for positive stops. Check idle release, close throttle. | E1, 35 |
| 10. | Avionics - OFF, set as required. | |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

11. Systems Instruments - Check:

NOTE

**Any round instrument which has a range marking on glass face must also have a white slippage mark from the glass to frame.**

a. Gas producer tachometer -
Red line - 105%
Green arc - 62 to 105%

b. TOT gauge -
Red dot - 927°C
Red line - 810°C
Yellow arc - 738°C to 810°C double lines
**Green arc - 300°C to 738°C**
Red chevron - between 810°C and 900°C

c. ENG OIL -
Temperature -
Red line - 107°C
Green arc 60°C to 107°C
Pressure -
Red lines - 50 and 130 psi

**CAUTION**

**Disregard yellow and green instrument markings for engine oil pressure.**

Green Arc - 50 - 130 psi Idle to 78% N1
90 - 130 psi 79% to 89% N1
115 - 130 psi 90% N1 and above

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**BEFORE STARTING ENGINE CHECKS (CONT)**

d. XMSN OIL pressure -
Red lines - 30 psi and 70 psi
Green arc - 30 psi to 60 psi
Red chevrons - between 80 and 100
between 0 and 20

e. AMPS meter -
Red line - 140 amps

f. FUEL QTY -
Yellow arc - 0 to 65 lbs double lines

g. TORQUE meter -
Red line - 100%
Green arc - 0% to 85%
Yellow arc - 85% to 100%
Red chevrons - between 100 and 110%
between 110 and 210%

h. Dual tachometer -
Power turbine -
Red dot - 110%
Red line - 100%
Green arc - 98% to 100%
Rotor -
Red lines - 93% and 110%
Green arc - 93% to 110%
Yellow arc - 49% to 58% double lines

12. Clock - Wound and running. B18

13. Flight Instruments:

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**NOTE**

**Any round instrument which has a range marking on the glass face must also have a white slippage mark from the glass to frame.**

| | | |
|---|---|---|
| a. | Airpeed indicator - Check static indication, range markings, and note that reading is correct for conditions. Red line - 120 kts Blue line - 100 kts Green arc - 0 - 120 kts | B16 |
| b. | Attitude indicator - Warning flag visible. Rate of turn pointer out of view. Ball centered, full of fluid. | B17 |
| c. | Gyro compass - OFF flag visible, deviation card calibrated within last 12 months. | |
| d. | Omni bearing selector - OFF flags visible, needles centered. | |
| *e. | Altimeter - Set to airfield elevation, except AIMES. | B15 |
| f. | VSI indicator - Check indication. | B16 |
| g. | Magnetic compass - Check fluid level, no discoloration, approximate correct heading, deviation card calibrated within last 12 months. | B19 |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**BEFORE STARTING ENGINE CHECKS (CONT)**

14. Misc Control Panels and Switches:
    a. IFF code hold switch - OFF.
    b. RMI BRG PNTR switch - As required.
    c. DIR GYRO/MAG switch - MAG.
    d. FORCE TRIM switch - FORCE TRIM.
    e. HYD BOOST switch - HYD BOOST.
    f. FUEL BOOST switch - OFF.
15. Cockpit Utility Light - OFF.
16. Heater Rheostat - Check for smooth operation and contact of both stops. Turn off (counter clockwise). — E30
17. Overhead Circuit Breakers and Switches:
    a. Circuit breakers - All in.
    b. CONSOLE and INST LTS rheostats - As required.
    c. ANTI-COLLISION LTS switch - ON. — C27, 28

| PROCEDURE | | TROUBLESHOOTING REFERENCE |
|---|---|---|
| d. | POS LTS switch - As required. | C19, 20 |
| e. | CSL LT switch - As required. | |
| f. | Auto ENG OIL switch - OFF. | |
| g. | HTR switch - OFF. | |
| h. | DEFOG & VENT switch - OFF. | |
| i. | PITOT HTR switch - OFF. | |
| j. | ENG DEICE switch - OFF. | |
| k. | INV switch - OFF. | |
| l. | NON ESS BUS switch - MAN. | |
| m. | GEN switch - OFF. | |
| n. | BAT switch - ON (OFF for GPU start). | C1-5 |
| o. | AUX RECP switch - OFF. | |
| 18. | Fuel Valve Handle - Check for smooth operation and positive on/off position, threads in witness hole, cotter keys present, cracks and excessive grooves on lever arm. Leave in forward (on) position and lock into detent. | |
| *19. | FAT Gage - Check reading and condition. | B27 |
| 20. | Ground Power Unit - Connect for GFU start. | C25, 26 |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**BEFORE STARTING ENGINE CHECKS (CONT)**

21. Light System Checks:

| | | |
|---|---|---|
| a. | Cockpit light - Check condition and smoothness of operation of rheostat. Check both red and white positions operational. Leave in red and off. | C7 |
| b. | Interior lights - Check operation of console and instrument light. | B25, B1, B2, D15 |

*22. Warning Lights:

| | | |
|---|---|---|
| a. | ROTOR RPM light - ON. | B25, B28 D16 |
| b. | ENGine OUT light - ON. | B25, B1, B2, D15 |
| c. | XMSN OIL PRESS light - ON. | B25, D15, F2 |
| d. | XMSN OIL HOT light - OFF. | B25, D15, F3 |
| e. | Warning lights - Press-to-test. | B25, D15 |
| | XMSN OIL HOT light - ON when switch is depressed. | B25, D15 |

| | | |
|---|---|---|
| *23. | Caution Panel - Check, MASTER CAUTION light - ON. Hold test/reset switch to test and check all caution lights on. Check dim capability with INST LTS rheostat offset from DIM position. Reset caution lights. All caution lights should be off except INST INVERTER, DC GENERATOR and HYD PRESS. | C17, 18 D1-10 15, 16, 18, 19, F9 |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|
| 24. Misc Caution Lights: | C7b |
| a. IFF CODE MODE light - ON when pressed. | D1 |
| b. Deleted. | |
| c. PRI DIR CONTR - JAM and DISENG lights - ON when depressed. | D1 |
| d. ENGINE RELIGHT - ON when pressed (if installed). | |
| 25. Misc Instruments: | |
| a. Engine OIL TEMP gage - Check against FAT gage for approximately correct indication. | B22-24 |
| b. FUEL QTY - Check. | B3-6, 27 |
| c. AIMES Altimeter - Set (if installed). | B14 |
| 26. Engine Out/Low Rotor Audio - Check by raising collective. Audio should be heard when collective is raised approximately one inch. | B1, 2<br>K2 |
| 27. GOVERNOR RPM Switch - DECR for seven seconds. | E7, 8 |
| 28. Throttle - Check closed. | |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**BEFORE STARTING ENGINE CHECKS (CONT)**

29. Starter/Ignition Lock Switch - ON.

**STARTING ENGINE CHECKS**

1. Fireguard - Posted.
2. Rotor Blades - Check clear and untied.

**CAUTION**

**Refer to TM 55-1520-235-10 for engine starting limits. Abort start if abnormal conditions are noted.**

**CAUTION**

**In the event of a GPU failure during starting, a complete electrical failure will be experienced. Most engine monitoring gages and the starter will cease to function. A hot start could occur. Immediately close the throttle, place the battery switch on and complete abort start procedures. Note peak TOT and record on DA Form 2408-13.**

3. Engine Start:

| | | |
|---|---|---|
| a. | FUEL BOOST switch - FUEL BOOST, note momentary illumination of fuel boost caution light, then out. | C30, 32, E2 |

| PROCEDURE | | TROUBLESHOOTING REFERENCE |
|---|---|---|
| b. | STARTER switch - Press and hold. Start time. | A1-11, C1, 2 |
| c. | TOT - Check below 200°C. | B21-24 |
| d. | THROTTLE - Open to engine idle at peak of N1 RPM, provided the following limits are maintained: | E1-6 E15, 16, 26 |

| FAT | MINIMUM |
|---|---|
| 7°C and above | 15% |
| 7°C through -18°C | 13% |
| -18°C and below | 12% |

| | | |
|---|---|---|
| e. | ENG OIL PRESS - Check for increase by 20% N1 RPM or abort start. | B29-34 |
| f. | MAIN ROTOR - Check turning by 30% N1 RPM or abort start. | A8, 10 |
| *g. | TOT - Monitor for overtemperature conditions and record peak indication. | B21-24 |
| h. | ENG OUT light - Check out at 55 ± 3% N1 RPM. | B12 |
| *i. | STARTER switch - Release at 58-62% N1 RPM and record duration of start time. | A5, 9, 11 |
| j. | ENG OIL PRESS - Check indication. | B29-32 |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**STARTING ENGINE CHECKS (CONT)**

| | | |
|---|---|---|
| k. | XMSN OIL PRESS - Check indication and warning light out. | B36, F1 |
| l. | TORQUEMETER - Check indication by 62% N1 RPM. | B7-10 |
| m. | GAS PRODUCER - Approximately 62-64% N1 RPM. | E3, 4, 9 E20 |
| n. | DUAL TACH - Check stabilized within one needle width. | B12, 13 |
| o. | CAUTION lights - All out except DC GEN and INST INV. | D1-5, 17, 18 |
| p. | GPU - Disconnect (if used). | |

**CAUTION**

**Check GPU disconnected prior to turning the battery switch on.**

| | | |
|---|---|---|
| q. | BATTERY switch - BATT (GPU start). | C6 |
| r. | GEN switch - GEN, check caution panel lights out, check Ammeter, N1 and TOT. Monitor Ammeter for gradual decrease in amps. | C6-11, 17 D3, 12, 16 |
| s. | NON-ESS BUS switch as required. | |

| PROCEDURE | | TROUBLESHOOTING REFERENCE |
|---|---|---|
| t. | Caution Panel and Master Caution lights - Out, except for INST INV. | D1-18<br>F1, 3 |
| u. | Check for leaks. | E22-25<br>28, 34<br>F5-8 |
| v. | Circuit breakers - All in. | C16 |
| w. | ENG OIL TEMP - Check for indication and rising. | B33-34 |

**ENGINE RUNUP CHECKS**

*1. Cyclic Check:

**CAUTION**

**Limit cyclic to two inches maximum displacement from center.**

| | | |
|---|---|---|
| a. | FORCE TRIM ON - Check for positive feeling of force gradient springs. No loose play allowed. Check for approximately equal forces needed to offset cyclic into lateral and fore and aft positions. Check operation of both cyclic force trim interrupter switches. Note both cyclic sticks equally aligned. | G3, 4<br>8, 9,<br>10, 11,<br>13, 14,<br>15 |
| b. | FORCE TRIM OFF - Check for creep. Check for freedom of movement. No binding or restriction allowed. | G3, 4<br>H1, 2,<br>12 |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|
| **ENGINE RUNUP CHECKS (CONT)** | |
| c. Use spring scale to check all quadrants for equal force of one pound ±0.5 pound. FORCE TRIM ON after check. | G7 H1, 2, 12 |
| *2. Collective Check: | |
| a. Raise collective a maximum of 1/2 inch. Use spring scale to check built-in friction of 4 or 6 pounds. Collective down. | G3, 4 9, H6 |
| b. Raise collective to mid-travel while checking for binding and hard spots. Observe control reaction and that HYD BOOST light remains out. Collective down. | G3, 4, 9,11 H7, D13 |
| c. Collective friction on. An acceptable increased force should be required to move the collective. Collective down, friction off. | H5, 6, 7 |
| *3. Hydraulic System Check: | |

**CAUTION**

**Before any movement of controls with the hydraulic system off, both hands must be on the controls.**

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**CAUTION**

**Brief copilot/observer not to remove his hand from hydraulic control switch unless instructed to do so. Be prepared for possible up forces on collective. If up forces are excessive, return switch to on. This condition must be corrected before continuing.**

**CAUTION**

**Limit cyclic movement to two-inch maximum displacement.**

| | | |
|---|---|---|
| a. | FORCE TRIM OFF, HYD BOOST switch OFF, RESET caution panel. Check for unusual forces or feedback while moving cyclic. | G2, 5 |

NOTE

**Feedback forces will be encountered when moving the cyclic stick. If hydraulic servos are functioning properly, negligible forces will be required to maintain a given stick position once the stick is stopped.**

| | | |
|---|---|---|
| b. | Check that collective can be moved up to about mid-travel and moved full down. | G5, 10, 11 |
| c. | Pull HYD BOOST SOL circuit breaker to check fail safe system. HYD BOOST switch ON, circuit breaker in. Check HYD PRESS light out. | G2, D13 |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**ENGINE RUNUP CHECKS (CONT)**

| | | |
|---|---|---|
| *4. | Primary directional control electro-mechanical disconnect - Check as follows: | H21, 23 |
| a. | PRI DIR CONT switch - DISENG. The DISENG light should illuminate. | |
| b. | PRI DIR CONT switch - ENGAGE. The DISENG light should go out. | |

NOTE

**Only physical movement of the yaw control tube will assure proper operation of the jam light. The jam light check is not a required part of this check.**

CAUTION

**Observe engine overspeed limitations during checks 5 and 6.**

| | | |
|---|---|---|
| 5. | Throttle - Slowly increase to full open, note 94% N2 RPM. Check | E1, 6, 9, 11, 16, 17, |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|
| all instruments and lights are normal. Check for high frequency vibrations. | 20, 21, 27 |
| 6. GOV RPM Switch - Carefully increase to 101%. Check for 7% spread. Decrease to 94% and note travel time of 5 to 10 seconds. Actuator should operate smoothly. Increase to 100% N2. | B12, E7, 8, 10-12, 20, 21, |
| 7. Cyclic Friction Check. Force Trim OFF - Cyclic friction full on. Insure cyclic can be moved without excessive force. Check that both cyclic sticks are equally aligned. Friction off. FORCE TRIM ON. | H1, 2, 12 |
| 8. Compressor Bleed Valve Check: | |
| **NOTE**<br>**Insure aircraft and engine are properly prepared for this check. Refer to TM 55-2840-241-23.** | |
| a. Have observer with flashlight monitor bleed valve. For communication between pilot and observer, use helmets and extension cord to passenger communication box. | |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**ENGINE RUNUP CHECKS (CONT)**

b. If bleed valve is not in closed position, apply collective until valve is fully closed.

**NOTE**

**If FAT is 17°C or higher, it may be necessary to increase aircraft gross weight.**

c. With bleed valve closed, friction collective and reduce throttle to engine idle. Let N2 stabilize. Observer should check that bleed valve is fully open.

*d. Slowly increase throttle until observer indicates bleed valve starts to close. Record N1.

*e. Continue to increase throttle until observer indicates bleed valve is fully closed. Record N1.

f. Check compressor bleed valve chart for correct operating range of the bleed valve. Refer to TM 55-2840-241-23.

**CAUTION**

**Insure aircraft and engine are prepared for flight after above check.**

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

9. Collective - Down. N2 - 100%.

**CAUTION**

**If torsional oscillation does not dampen by 10 cycles, the throttle will be immediately retarded to eliminate the effect of an unstable N2 governor. If torsional oscillation is not corrected and exceeds 10 cycles, damage to the aircraft may occur.**

**CAUTION**

**Brief copilot/observer to guard pedals by placing his feet approximately 2 inches from the pedals to insure pilot does not exceed pedal travel limits.**

*10. Torsional Oscillation Check - Induce oscillation by making short, quick inputs on the anti-torque pedals. Limit pedal travel to 1 inch. Oscillations should dampen out prior to a maximum of 10 cycles. Monitor N2 tach and torque for excessive oscillation. J5

NOTE

**Torsional oscillation check must be performed after an engine change, phase inspection, or a change of or adjustment to the engine fuel control, N2 governor, double check valve, accumulators or pneumatic lines.**

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**ENGINE RUNUP CHECKS (CONT)**

*11. FUEL BOOST PUMP Check:

| | | |
|---|---|---|
| a. | FUEL BOOST PUMP circuit breaker - Out. Check fuel boost caution light on, reset caution panel lights, master caution light out, stabilize 30 seconds. | C29, 31, E2 |
| b. | Throttle - To engine idle, stabilize 15 seconds, check for stable N1. | |
| c. | FUEL BOOST PUMP circuit breaker - In. Note on more than 5 amp increase in ampmeter and fuel boost caution light out. | C16, 31 D4, E2 |

12. Engine Idle Speed:

**NOTE**

**Dual control installation requires an idle speed check from the copilot's side also. Idle speed may be approximately one-half percent higher on copilot's twist grip, but no lower.**

***GENerator switch - OFF. Check engine idle speed 62 to 63% N1.** E3, 4

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**ENGINE RUNUP CHECKS (CONT)**

13. Gas Producer Fuel Control Deceleration Check; Complete (as required) as follows: A12

    a. Collective Down.

    b. Throttle - Full open, N2 RPM 100%. Stabilize at least 15 seconds.

    c. Throttle - Idle. Simultaneously start time.

    d. As N1 passes through 65%, note time.

**NOTE**

**Practice and/or retakes may be required before proficiency is obtained in timing the deceleration.**

    e. Check deceleration time. Minimum allowable time is 2 seconds. If deceleration is less than 2 seconds, make two more checks to confirm the time.

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|
| **ENGINE RUNUP CHECKS (CONT)** | |
| **f. If deceleration time is less than 2 seconds, the aircraft will not be flown until corrective action is accomplished. Refer to TM 55-2840-241-23.** | |
| 14. GENerator Switch - GEN. Generator light out. | C6-10 D3, 12 |
| 15. DC Amps - Check Indication. DC Amps must indicate 60 or less before the inverter is turned on. | |
| 16. INVERTER Switch - ON/OFF flags on RBI and attitude indicator should not be visible after 5 minutes max. Check INST INVERTER caution light OUT. | B14, 20 C12, 13 16, D1 3, 11 |
| 17. Avionics - ON. Note no large fluctuation of ampmeter while turning avionics on. | C16, D17, K1, 3, 4, 5 |
| 18. Throttle - Increase smoothly to full open, increase N2 RPM to 100% with governor control. | |
| 19. Engine Deice Check - ENG DEICE switch ON, note approximately 20°C TOT rise. ENG DEICE switch OFF, note TOT decrease to normal. Set switch as required for conditions. | C16, 30, E13 |

| PROCEDURE | | TROUBLESHOOTING REFERENCE |
|---|---|---|
| 20. | Pitot Heater Check - PITOT HTR switch ON, note rise in ammeter. Switch OFF, note decrease in ammeter. Set switch as required. | C14, 16 |
| 21. | DEFOG & VENT check - DEFOG & VENT switch ON. Note rise in ammeter and swing in mag compass. Note both blower motors operate properly and check for excessive noise in headset, caused by blower motors or failure of noise suppressors. Check proper operation of defog and vent pull levers. | C16, 23, 24 |
| 22. | Heater Check - HTR switch ON, check no TOT rise or warming air from outlets. Rotate heater rheostat on, check approximately 20°C TOT rise and warming air from outlets near pilot's and copilot's sticks and outlets near both door posts in passenger compartment. Close outlets and check for warming air from defog vents. Defog and vent switch OFF, defog and vent levers in, HTR switch OFF. Check for drop in TOT and ammeter. | E30, 31, 32 |
| *23. | Record following Instrument Indications: | |
| a. | N1 - Stabilized. | E9, 20 |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|
| **ENGINE RUNUP CHECKS (CONT)** | |
| b. TOT - Note stabilized and normal for ambient condition. | B21-24, E9 |
| c. ENG OIL temp - Note stabilized and normal for ambient condition. | B33, 34 |
| d. ENG OIL press - Note stabilized and as required for N1 speed. | B29, 32 |
| e. XMSN OIL pressure - Note stabilized and between 40 to 60 psi. | F1 |
| f. TORQUEmeter - Note stabilized and reading between 23 and 29%. | B8, 9, 10 |
| 24. DUAL TACH - Note needles joined and steady. | B11-13, 26 |
| 25. Perform avionics checks IAW applicable TMs. | |
| 26. RBI - Check nulled and proper indication. | B20 |
| 27. Flight instruments - Check normal, set altimeter to current setting (± 70 feet maximum error). | B15, 16 17, 19, 20 |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

28. Cyclic and collective friction - As desired (recommended OFF for test flights).

29. FORCE TRIM - As desired (recommend OFF for test flight.)

30. HIT Check Complete.

**NOTE**

**HIT check may be deferred until arrival in test flight hover area if conditions in runup area preclude accurate and/or safe completion of check. HIT check must be completed prior to takeoff.**

**BEFORE TAKEOFF CHECKS**

1. N2 - 100%.
2. Warning Lights - Out.
3. Engine Instruments - Normal range.
4. Fuel - Check quantity.
5. Caution Lights - Out.

**CAUTION**

**Seat belts and shoulder harnesses must also be properly fastened and tightened when seats are not occupied.**

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**BEFORE TAKEOFF CHECKS (CONT)**

6. Crew, Mission Equipment and Seat Belts (inside aircraft) Check.

7. Transponder - As required.

8. Doors - Secure.

**AIRCRAFT HOVER CHECKS**

NOTE

**After installation of MWO 55-1520-228-50-25, with Pilots pedals centered, Tail Rotor pedals on observer side may be offset.**

| | | |
|---|---|---|
| *1. | Takeoff to Hover - Carefully bring aircraft to a 3-foot hover. Closely monitor control response and C.G. hang as aircraft departs ground. At a hover observe copilot controls are positioned approximately the same as pilot controls, droop compensation maintains constant N2 speed of 100% and check all instruments normal. Turn aircraft into the wind and check cyclic, collective and pedals are positioned normally for conditions and power required. | E9, 16, 19, 20, 21, 29, G3, 4, H1, 3, 4, 7, 15-18 19, J3, 4 |
| *2. | Hover Power Check - While at a stabilized 4-foot hover into the wind, record torque, TOT, and N1. Readings should be normal for conditions. Check torque with Performance Planning Card. | B8, 9, 10, E9 |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|
| 3. Check parking area for indication of leaks. | |
| 4. Slowly hover to test flight hover area. | |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**NOTE**

**If HIT check has been deferred, performance of the check is required at this time.**

5. Make 90° pedal turns in both directions into the wind to check tail rotor response and rigging. — H3, 4, 19, J3, J4

6. Primary Directional Control Check:

**CAUTION**

**Should pedal control become difficult or should pedal contact stops, immediately terminate the check, land the aircraft and make an entry in DA Form 2408-13.**

a. Place the PRI DIR CONTROL switch to the DISENG position. DISENG light should illuminate.

**NOTE**

**JAM light will not illuminate with the ENGAGE/DISENGAGE switch in the DISENGAGE position.**

b. With the aircraft heading into the wind, smoothly apply collective pitch until a 3-foot hover is attained. Check controllability of tail rotor by making pedal turns 90° left and right.

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|
| **AIRCRAFT HOVER CHECKS (CONT)** | |
| c. Land aircraft. | |
| d. PRI DIR CONTROL switch - ENGAGE. Note jam light illuminates. Move pedals slightly to reengage system - Note DISENG light out. | H19, 20, 21 |
| e. PRI DIR CONTROL switch - RESET. Note jam light out. | |
| 7. Perform sideward flight into the wind in both directions to check cyclic response and rigging. Limit ground speed to 5 kts. | G1, 3, 4, H1, 3, 4, 15, 16, 17, J3, 4 |
| 8. While maintaining 5 feet AGL, fly forward and rearward into the wind until effective translational lift is reached. Check cyclic response and rigging, abnormal vibrations and/or flight control displacement. | G1, 3, 4, H1, 3, 4, 15-18, J2, 3, 4 |
| *9. Pylon Isolation Mount Check - While maintaining a 3-foot hover, move the cyclic fore and aft (about 3 to 4 inches) fairly rapdily along a straight line to induce an extremely low frequency vibration. Stop the cyclic in the neutral position and check that the vibrations dampen out after 3 to 5 cycles. No abnormal vibrations or engine surges are allowed. | F4, G3, 4, 8, J2 |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

10. Land aircraft.

*11. Power Cylinder Check:

**CAUTION**

**Brief copilot/observer to hold HYD BOOST switch throughout following check. Should cyclic jam or become hard to move, instruct copilot/observer to turn the HYD BOOST switch off, then on. If cycling the switch does not release controls, turn HYD BOOST switch off and accomplish a hydraulics off landing.**

a. Climb and maintain a 10-foot hover, smoothly move the cyclic along a straight line from left rear to right forward. The length of cyclic movement should be approximately 6 inches either side of the center position. No restriction to movement should be felt and the HYD PRESS caution light should not illuminate. — G1, 3, 4, 6-9, H1, 17, J3

b. Repeat the procedure moving the cyclic from right rear to left forward.

c. Return to normal hover altitude upon completion of the check.

**CAUTION**

**Do not exceed helicopter limits during power applications.**

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**AIRCRAFT HOVER CHECKS (CONT)**

**CAUTION**

**N2 may temporarily overspeed or underspeed the RPM selected for a period of approximately 2 to 5 seconds if the collective is moved abruptly.**

*12. Engine Response Check - While maintaining all instruments within normal ranges, increase the collective fairly rapidly and check for nearly instantaneous increase in N1 speed (less than one second).Stop ascent before excessive altitude in gained and descend to normal hover altitude. Engine should respond smoothly and rapidly. — E9, 16, 20, 21, 29

*13. Before Takeoff Check:

a. N2 - 100%.

b. Warning lights - OUT.

c. Engine instruments - Normal range.

d. Fuel - Check quantity.

e. Caution lights - OUT.

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**CAUTION**

**Seat belts and shoulder harnesses must also be properly fastened and tightened when seats are not occupied.**

f. Crew, mission equipment, and seat belts (inside aircraft) - Check.

g. Transponder - As required.

h. Doors - Secure.

INFLIGHT CHECKS

**CAUTION**

**If excessive vibrations are felt or other indications exist that preclude further safe flight, land and/or return to maintenance area and correct before continuing.**

1. Takeoff:

a. Perform normal takeoff (500 FPM - 60 KIAS). Check that control position and instrument indications are normal for conditions. — E16, 18-21, 27, G1, 3, 4, H1, 3, 16, 17, J1, 2, 3

b. Initiate fuel consumption check.

*2. Control Rigging Check:

**NOTE**

**Perform checks 2 thru 6 into the wind.**

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|
| **INFLIGHT CHECKS (CONT)** | |
| a. While maintaining aircraft in trim, increase airspeed to 100 KIAS using 65% torque. Force trim ON. Check that cyclic remains in place when hand pressure is relaxed. Force trim OFF. | E16, 27, H2 9, 10, 14, 15, 16, |
| b. Check pedal position. One or two inches of forward right pedal is normal. Relax pedal pressure. Pedals should not creep. After compliance with MWO 55-1520-228-50-25, approximately one-half inch of forward right pedal on Pilot's side is normal. Inflight pedal position is an approximate indicator. Primary check for tail rotor rigging will be accomplished before aircraft is released for test flight. | J1, 2, 3 H19 |

*3. Autorotation RPM:

**WARNING**

**If autorotation RPM cannot be maintained in the green, terminate the test flight.**

**CAUTION**

**Autorotation will be entered at an altitude that will allow power recovery to be completed prior to 500 feet AGL.**

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

NOTE

**Insure engine deice and/or bleed air is off prior to next check.**

a. While keeping a suitable landing area within reach at all times, enter autorotation at 55 KIAS into the wind. Do not allow rotor

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

RPM to exceed limits. Stabilize autorotation, note N1%, and record rotor RPM. Check adequate pedal to maintain trim and no unusual cyclic position required to maintain desired attitude. Note vibration level or a marked decrease in vibration level. Note torque at/or near zero and no warning or caution lights on. Initiate power recovery from the autorotation.

b. After power recovery, compare autorotation RPM against figure below. If recorded rotor RPM in autorotation does not compare with figure below, adjust as necessary. — B12, 26, F10, H3, 4, 16

| Mission Gross Weight | Approx. RPM @ 55 KIAS |
|---|---|
| 3200 lbs | 105% |
| 2700 lbs | 100% |
| 2200 lbs | 93% |

4. Engine Performance Check:

a. An engine performance check is required after any of the following maintenance actions are completed.

(1) After installation of engine.

(2) Anytime poor performance is noted.

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

INFLIGHT CHECKS (CONT)

(3) Removal/replacement, repair, adjustment of fuel control, governor, double check valve, compressor.

(4) Removal/installation of reverse flow inlets.

(5) Anytime a pneumatic line is loosened.

(6) Calibration/replacement of TOT indicating system.

(7) Replacement of FAT gage.

**CAUTION**

**Do not exceed any operating limits.**

b. Compute the attitudes required and torque values before performing check. Perform check as follows:

**NOTE**

**Maximum power available is achieved when the limits of either TOT, torque, or N1 speed are reached at 100% N2.**

**NOTE**

**Insure all bleed air systems are off prior to next check.**

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**NOTE**

**Transient Droop may occur and N2 speed may droop below 100% N2. This droop should recover within 2-5 seconds.**

**NOTE**

**Insure that all non-essential electrical items are turned off prior to the next check.**

(1) Establish normal cruise flight at an altitude of 1,500 feet AGL or above.

(2) Set altimeter to 29.92.

(3) Initiate a climb at approximately 500 FPM and approximately 70 KIAS. At 300 to 400 feet prior to teaching your test altitude of 1,000 feet above the selected cruise altitude, slowly increase the collective so that the maximum limit of TOT, N1 speed, or torque is achieved at your test altitude.

(4) Upon reaching your test altitude and the maximum limit of TOT, N1 speed or torque, record the following:

a. Pressure altitude.

b. FAT.

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**INFLIGHT CHECKS (CONT)**

c. **Torque achieved.**

d. N1 speed.

e. TOT.

(5) Refer to chapter 7 of TM 55-1520-235-10 and select the appropriate chart for the maximum torque available (30 min. operation). Enter the chart at the selected test altitude, move right to the FAT, and then down to the torque value. Compare the actual torque value against the torque value shown on the chart.

(6) If you were able to achieve or surpass the chart torque value, continue the test flight.

(7) If you were unable to achieve the chart torque value or you reached the limit of either N1 speed, TOT, and/or the N2 started to bleed off, discontinue test flight and refer to TM 55-2840-241-23 for troubleshooting procedures.

**NOTE**

**Insure that the correct charts were used and that the derived torque values were accurate.**

| ROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

(8) Reset the altimeter to the current setting.

5. Hydraulic OFF Check:

**CAUTION**

**Brief copilot/observer not to remove hand from HYD BOOST switch until instructed to do so. If any control problems or abnormal forces are encountered, the copilot/observer should be instructed to place the HYD BOOST switch on.**

a. While maintaining approximately 70 KIAS for easier controllability, turn HYD BOOST switch OFF. Check that the cyclic is easily controlled and no abnormal forces are present. More force should be needed to move the cyclic right forward then left forward. — D3, G2, 5

b. Decrease and increase collective and check that at least 17% down and 83% up can be reached without excessive pressure. Do not exceed any limitations during this check. HYD BOOST switch, ON. Record actual % reached. — G5, H20, D13

**CAUTION**

**Insure safe forced landing area is within reach at all times during OGE hover.**

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|
| **INFLIGHT CHECKS (CONT)** | |
| *6. Vibration Analysis - When electronic balancer not available (See Section IV for detailed procedures and Section III, J Troubleshooting References.) | |
| **NOTE** | |
| **OGE not required when using vibrex for vibration analysis.** | |
| *7. Flight Instruments Check - Fly at different attitudes and airspeeds to check performance of flight instruments. | |
| **NOTE** | |
| **Eliminate or minimize all main rotor vibrations prior to the following checks:** | |
| a. Airspeed indicator - Check proper indication for known torque setting and no excessive fluctuation. | B16 |
| b. IVSI - Proper indication for straight and level flight (±50 FPM). | B16 |
| c. Attitude indicator - Correct indication, no excessive oscillation or precession. | B14 |
| d. Turn and slip indicator - Check proper indication, freedom of | B17 |

| PROCEDURE | | TROUBLESHOOTING REFERENCE |
|---|---|---|
| | movement, no large fluctuations. Perform timed turns. | |
| e. | Mag compass - Check flying over known heading, no excessive fluctuation. | B19 |
| f. | RBI - Check flying over known heading, smooth operation during turns, no binding or fluctuation. No excessive oscillation or precession. | B20 |
| g. | Clock - Check still operating and indicating correct time. | B18 |
| h. | Radar altimeter - Check for proper operation (if installed). | B15 |
| i. | All instruments - No excessive vibrations or fluctuations of instruments, mounts or frames. Observe for looseness or cracks at pedestal mounts. | B26 |
| 8. | Communication and Navigation Equipment Check: | |
| a. | Transponder - Contact radar controller and request a transponder check to include EMER mode. | K1 |
| b. | ADF - Fly over operational NDB station maintaining visual track. Check proper operation. | K4 |
| c. | FM radios - Check reception and transmission capability on at | K1, 2, 3 |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|
| **INFLIGHT CHECKS (CONT)** | |
| least 2 frequencies. Check homing indication on one frequency. | |
| d. VHF radio - Check reception and transmission capability on at least 2 frequencies. | K1, 2 |
| e. UHF radio - Check reception and transmission capability on at least 2 frequencies. | K1, 2 |
| f. KY-28 and T-SEC 1/A - Check, if installed. | K5 |
| g. AN ARN-123 - Fly ILS and VOR instrument approaches maintaining visual track. Check proper operation (if installed). | K1, 2, 4 |
| **BEFORE LANDING CHECKS** | |
| 1. N2 - 100%. | |
| 2. Systems - Check. | |
| 3. Crew - Check. | |
| 4. Landing Light - As required. | C21, 22 |
| **AFTER LANDING CHECKS** | |
| 1. Landing Light - As required. | |
| 2. Transponder - As required. | |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**ENGINE SHUTDOWN CHECKS**

| | | |
|---|---|---|
| 1. | Landing Light - OFF. | |
| 2. | Collective - Full down. | |
| 3. | FORCE TRIM - ON. | H8 |
| 4. | Cyclic and Collective Friction - ON. | |
| 5. | Battery Check - BATT switch OFF. If drop in ammeter is less than 5 amps, the battery is fully charged. BATT switch ON. | C1, 2, 6 |
| *6. | Note and Record Following Instruments - ENG OIL PRESS (as required for N1 speed), ENG OIL TEMP, TORQUE, TOT, N1 and XMSN OIL PRESS. | |
| 7. | Avionics, Elec Switches - OFF, except GEN, BATT and ANTI-COLLISION lights. | |

**NOTE**

**If rotor RPM warning system is installed, raise collective approximately one inch prior to next item.**

| | | |
|---|---|---|
| 8. | Throttle - Slowly reduce. Check low rotor RPM audio activators and the rotor light is on at 95 ± 1.4% rotor RPM. When audio activates lower collective and reduce throttle to eng idle stop. | E1, B28 |

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|

**ENGINE SHUTDOWN CHECKS (CONT)**

9. Special Equipment - Perform operational checks on all special equipment installed.

10. Idle Cutoff Check:

**NOTE**

**Allow TOT to stabilize for two minutes before performing idle cutoff check.**

a. Rotate throttle 1/16 inch below eng idle stop. — E3, 35

b. Stabilize for 15 seconds, N1 must remain stable and engine must not quit.

11. Engine Shutdown:

a. On aircraft without low rotor RPM warning system raise collective 1 inch and close throttle. Check engine out audio and engine out light on by 55 ± 3% N1. Listen for abnormal noises, monitor TOT. — B1, 2, E22, 23, 26, 35

b. On aircraft with low rotor RPM warning system close throttle. Check engine out light on by 55 ± 3% N1. Listen for abnormal noises, monitor TOT. — B1, 2, E22, 23, 26, 35

12. Fuel Boost - OFF.

| PROCEDURE | TROUBLESHOOTING REFERENCE |
|---|---|
| 13. GENerator Switch - OFF. | |
| 14. Lights - OFF when rotor is stopped. | |
| 15. BATTery Switch - OFF. | |
| 16. Starter/Ignition Lock Switch - OFF, remove key. | |
| 17. Main Rotor Blade - Tie down. | |
| 18. Engine Inlet Covers - Installed. | |
| *19. Post Flight Inspection - Completed. | |
| 20. Checksheet - Signed. | |
| 21. All Entries from "Remarks" Column of Checksheet - Transcribed to DA Form 2408-13. | |
| 22. Secure Aircraft. | |
| 23. Maintenance Personnel - Debriefed as necessary. | |

## SECTION III. TROUBLESHOOTING GUIDE

**General.** This section contains troubleshooting information that has been referenced in Section II checklists. This section shall list possible conditions, abnormal conditions and indications and probable causes. The information is to be used only as a quick reference and may not be all encompassing.

### TROUBLESHOOTING GUIDE A - STARTING

**CONDITION**

**PROBABLE CAUSE**

**A1. No start action.**

a. Circuit breaker out.
b. Battery power low.
c. Battery cable connector is not properly connected.
d. Starter switch inop.
e. Starter brushes excessively worn.
f. Faulty starter relay.
g. Faulty starter.
h. Wiring to starter shorted or broken.
i. Internal seizure of engine.
j. Starter/ignition lock switch not on.

**A2. No N1 indication, but starter turns.**

a. Faulty N1 tachometer transmitter or instrument.
b. Wiring open or shorted.
c. Starter drive failed.
d. Accessory gear box internal failure.

**A3. Unable to get sufficient N1 RPM for start.**

a. Weak battery output.

b. GPU underrated, (if used).

c. Too much electrical drain on battery.

d. Internal failure of engine.

**A4. Engine fails to light off.**

a. Air in fuel lines.

b. Faulty spark igniter.

c. Faulty circuit to ignition unit.

d. Faulty ignition exciter.

e. Engine pump inoperative. (Fuel vapor not observed leaving the exhaust.)

f. Fuel nozzle flow obstructed.

g. Gas producer fuel control remains in cutoff.

h. Contaminated fuel.

i. Fuel line disconnected.

j. Insufficient fuel in tank.

**A5. Engine lights off but will not accelerate to idle speed in 45 seconds.**

a. Inadequate torque at starter pad.

b. Air in fuel control.

c. Pneumatic line leak.

d. Defective fuel control.

e. Defective power turbine governor.

f. Start derichment valve out of adjustment.

**A6. Acceleration temperature too high during start.**

a. Dirty particle separator or compressor.

b. Obstructed air inlet.

c. Battery weak.

d. Residual TOT in excess of 200°C prior to start.

e. Throttle improperly rigged.

f. Leaking engine anti-icing valve or lines.

g. Faulty gas producer fuel control or start derichment is set too rich.

h. Faulty starter which is not capable of dry motoring gas producer N1 above 15%.

i. FOD or erosion to compressor.

**A7. Normal start, rotor turns but no N2 indication.**

a. Faulty tachometer instrument, transmitter or wiring.

b. N2 gear box internal failure.

**A8. Main rotor not turning by 30% N1, no N2 indication but normal N1 and TOT indications.**

a. Rotor still tied down, either main or tail.

b. Foreign object binding tail rotor drive.

c. Transmission or gear box failure.

d. N2 turbine failed or locked.

e. Engine gearing failure.

**A9. Unintentional start termination.**

a. STARTER switch released too soon.

b. FUEL VALVE shut off.

c. Circuit breaker pops (starter or ignition).

d. Starter failure (electrical or mechanical).

e. Ignition system failure.

f. Fuel control malfunction.

**A10. Main rotor not turning by 30% N1: normal N1 N2, and TOT indication.**

a. Engine drive shaft failed.

b. Free wheeling unit failure.

c. Transmission failure.

**A11. Engine continued to accelerate above 64% N1.**

a. Throttle positioned above engine idle.

b. Engine idle improperly rigged.

c. Fuel control malfunction.

**A12. Gas producer fuel control deceleration check time is less than allowable.**

a. Deleted.

b. Perform rigging checks (N1 and N2).

c. Perform pneumatic leak check.

d. Perform Engine Performance Check to confirm there are no pneumatic leaks.

e. Check and clean PA screens on governor and fuel control.

f. Replace fuel control.

**TROUBLESHOOTING GUIDE B - INSTRUMENTS**

**CONDITION**

**PROBABLE CAUSE**

**B1. ENGINE OUT light or low ROTOR RPM light inop.**

a. Caution panel circuit breaker out.
b. Faulty warning system lights.
c. RPM sensors inop.

**B2. ENGINE OUT or low ROTOR RPM audio inop.**

a. Headset not plugged in completely.
b. CAUTION panel circuit breaker out.
c. Collective stick not raised the proper distance.
d. Faulty tone generator.
e. Faulty RPM sensor (N1 or rotor).
f. Engine out warning switch sticking.

**B3. Fuel quantity indicator reads low.**

a. System out of adjustment.
b. Tank unit has low capacitance.
c. Indicator defective.
d. Low fuel.

**B4. Fuel quantity indicator reads high.**

a. System out of adjustment.
b. Indicator defective.
c. Tank unit shorted.

**B5. Fuel indicator remains at one point.**

a. No DC power.
b. Defective indicator.
c. Coaxial lead grounded.

**B6. Fuel indicator remains at zero or below.**

a. Open or broken wiring.

b. Reversed polarity.

c. Indicator failure.

**B7. No torquemeter indication after start.**

a. Faulty indicator.

b. Clogged, disconnected, or broken pressure line.

c. No oil in system.

d. Torquemeter internal system malfunction.

**B8. Torquemeter fluctuates - no other instruments fluctuating.**

a. Restriction in pressure line.

b. Faulty indicator.

c. Air in pressure line.

d. Engine oil pressure improperly adjusted.

**B9. Low torquemeter indication.**

a. Faulty indicator.

b. Low engine oil pressure.

c. Clogged pressure line.

d. Gross weight lower than computed.

e. Performance Planning card incorrect.

**B10. High torquemeter indication.**

a. Faulty indicator.

b. Oil pressure and torquemeter lines switched.

c. Performance Planning card incorrect.

d. Torquemeter internal system malfunction.

**B11. N2 needles not joined.**

NOTE

**Normal unless not joined at higher ranges (94% N2).**

a. Instrument or tachometer generator malfunction.

b. Wrong instrument installed.

**B12. N2 tachometer fluctuates - no other engine instrument fluctuating.**

a. Instrument or tachometer generator malfunction, wiring loose, moisture in connector plugs.

b. Faulty double check valve.

c. Faulty gas producer fuel valve.

d. Faulty N2 governor.

**B13. N2 tachometer error.**

a. Faulty instrument or tachometer generator.

b. Wrong instrument or generator installed.

**B14. Attitude indicator does not work properly.**

a. AC power failure.

b. Circuit breaker out.

c. Loose connections.

d. Improper inverter output, voltage or cyclic rate.

e. Improper inverter input voltage.

f. Faulty indicator.

**B15. Altimeter reads incorrectly or fluctuates excessively.**

a. Leak in static lines.

b. Clogged port or line.

c. Defective instrument.

d. Water in static system.

e. Faulty indicator.

f. No electrical power to instrument.

**B16. Airspeed indicator and/or IVSI reads incorrectly or fluctuates excessively.**

a. Gusty winds.
b. Pitot tube restricted.
c. Static port or line clogged by water or dirt.
d. Leak in lines.
e. Defective indicator.

**B17. Turn and slip indicator needle erratic or inoperative.**

a. Sticking gyro.
b. Loose wire or connection.
c. No electrical power to indicator.
d. Defective instrument.

**B18. Clock not accurate.**

a. Not wound.
b. Defective clock.

**B19. Standby compass inaccurate, sluggish or erratic.**

a. Improper compensation.
b. Mounting bracket loose.
c. External magnetic interference.
d. Landing light on.
e. Defective instrument.

**B20. GYRO-SYN inaccurate or erratic.**

a. Compass slaving switch in MAG position or defective.
b. Improper adjustment of transmitter unit.
c. External magnetic interference.
d. Indicating system malfunction.
e. Gyro-Syn compass control malfunction.
f. AC voltage or cycles not correct.

**B21. TOT fluctuating, no other engine instruments fluctuating.**

a. Faulty indicating system.

b. Loose connections.

**B22. TOT shows excessive temperature (incorrect reading).**

a. Incorrect resistance spool.

b. Cracked or broken TOT wires.

c. Indicator in need of calibration.

**B23. TOT shows no reading on indicator.**

a. Loose connections on indicator lead spool resistor or terminal block.

b. Open circuit in indicator.

**B24. TOT shows incorrect reading.**

a. Harness not calibrated.

b. Defective gage.

c. Improper hardware installed.

**B25. Warning lights press to test inop.**

a. Faulty circuit or switch.

b. Bulbs burned out.

c. Dirty contacts.

**B26. Excessive instrument vibration.**

a. Main rotor severely out of track.

b. Mount of instrument loose or cracked.

**B27. FAT gage reading incorrect for known actual ambient temperature.**

a. Gage inop.

b. Gage probe damaged (overtorqued mount nut).

c. Direct sun rays on probe (normal).

**B28. ROTOR RPM light and/or audio warning not on below 93% rotor RPM.**

a. Rotor sensor inop.

b. Audio transmitter inop.

c. (Audio) Collective is not raised up high enough or engine out warning switch sticking.

d. Rotor transmitter inop.

e. Rotor or audio connector plugs disconnected.

**B29. No engine oil pressure indication.**

a. Engine oil pump inop.

b. Engine oil pressure line broken prior to reaching indicator.

c. Defective engine oil pressure indicator.

d. Engine oil pump prime has been lost.

**B30. Low engine oil pressure.**

a. Restriction in oil line going to indicator.

b. Increase in oil pump internal clearance.

c. Oil filter element restricted or oil contamination.

d. Defective ENGINE OIL PRESSure indicator.

e. Oil pressure regulator valve improperly adjusted.

f. Lack of oil in reservoir.

**B31. Excessive oil pressure fluctuation.**

a. Defective engine oil pressure indicator/regulator.

b. Air in pressure line.

c. Oil leaks.

d. Oil contamination and foaming.

e. Restriction in oil filter or pressure regulator.

f. Low oil supply.

g. Defective oil pump or pump inlet restricted.

h. Restriction in pressure line.

i. Internally kinked or twisted engine oil inlet line.

j. Contaminated or improper oil.

**B32. High oil pressure.**

a. Defective ENGINE OIL PRESSure indicator.

b. Pressure regulator valve improperly adjusted.

c. Contaminated or improper oil.

**B33. High engine oil temp with normal oil pressure.**

a. Defective ENGine OIL TEMP gage.

b. Defective bypass valve or low level warning switch.

c. Defective engine oil temp bulb.

d. Improper air flow to oil cooler area.

e. Contaminated or improper oil.

**B34. ENG OIL BYPASS light illuminates with a rise in engine oil temp and auto ENGINE OIL bypass switch in OFF position.**

a. Defective or improperly wired AUTO ENG OIL switch.

b. Shorted wire from low level warning switch to master caution panel.

c. Engine oil leak or low oil.

**B35. XMSN pressure gauge no reading, reads low, reads high, erratic.**

a. Defective transmitter.

b. Defective gauge.

c. XMSN oil pressure regulator defective.

d. No XMSN oil pressure.
e. Defective wiring or circuit breaker open.
f. XMSN oil low.

## TROUBLESHOOTING GUIDE C - ELECTRICAL

**CONDITION**

**PROBABLE CAUSE**

**C1. Battery will not hold charge.**

a. Charging rate too low.
b. Electrolyte level too low.
c. Inpurities in electrolyte.
d. Broken cell partitions.
e. Electrolyte overfilled.
f. Shorted or grounded wire.
g. Unbalanced cells.
h. Dirty or loose wire connections.

**C2. Short battery life.**

a. Improperly adjusted or defective voltage regulator.
b. Same causes as item C1 above.

**C3. Excessive loss of electrolyte.**

a. Poor servicing.
b. Charging rate too high.
c. Defective battery.

**C4. Battery terminals corroded.**

a. Loose connections at BATTERY terminal.
b. Battery case (leaking electrolyte).

**C5. Actuation of battery switch fails to turn on power.**

a. Battery relay defective.
b. Faulty wiring between relay and BAT switch.
c. Faulty BATtery switch.

**C6. Starter-generator produces voltage, but ammeter reads zero with GEN switch in on position and N1 at engine idle speed.**

a. Defective DC AMPS indicator.

b. Defective circuit breakers in ammeter circuit.

c. Broken or disconnected wire in ammeter circuit.

d. Broken or defective generator shunt terminal.

**C7. No generator voltage.**

a. At generator terminal.

(1) Defective generator.

(2) Brushes excessively worn.

(3) Brushes binding in holders.

b. On main DC buss.

(1) Defective generator switch.

(2) Defective line control relay.

(3) Defective generator shunt.

(4) Faulty voltage regulator.

(5) Faulty wire connections.

(6) Circuit breaker popped open.

c. On non-ess buss.

(1) Defective NON-ESS BUSS switch.

(2) Defective generator fail relay.

(3) Defective Non-Ess Buss relay.

(4) Defective or popped GEN & BUSS RESET circuit breaker.

**C8. Generator voltage varies excessively with changes in engine speed or electrical load.**

a. Defective voltage regulator.

b. Defective generator.

**C9. Ammeter fluctuates rapidly under steady load conditions.**

a. Intermittent short or loose wire.

b. Defective ammeter.

c. One anticollision light shorted, burned out or drawing more amps than the other.

**C10. Adjustment of voltage regulator does not move voltage within normal range.**

a. Defective voltage regulator.

b. Incorrect or faulty wiring.

c. Defective generator.

**C11. Ammeter not zero with generator switch in off position.**

a. Defective GENerator switch, (generator not actually off).

b. Defective ammeter.

**C12. Inverter fails to produce voltage to AC buss, RBI and/or attitude indicator.**

a. INV PWR circuit breaker out.

b. Defective inverter.

c. Faulty INV switch.

d. Faulty wiring or connection.

e. Improper DC voltage input.

f. Poor system grounding.

**C13. Improper inverter output voltage or frequency rate (cycles).**

a. Low input DC voltage.

b. High input DC voltage.

c. Defective inverter.

**C14. No ammeter indication when pitot heater turned on.**

a. Heater inop.

b. Defective PITOT HTR breaker switch.

c. Broken wire in system.

**C15. Instrument or console lights fail to brighten or dim as INST LTS or CONSOLE LTS knob is rotated.**

a. Defective rheostat.

b. Defective transistor dimmer element.

**C16. Breaker switch or circuit breaker trips.**

a. Short in switch/breaker or wiring.

b. Actual ampere overload on system.

**C17. One caution or warning light is dimmer than the others.**

a. Poor grounding.

b. Corroded lamp sockets or bulbs.

**C18. Caution light(s) fail to burn with circuit energized normal or test position.**

a. Broken lamp filament.

b. Corroded lamp socket or bulb.

c. Broken wire.

**C19. Position lights malfunction when POSition LTS switch is placed to bright position.**

a. Defective circuit breaker.

b. Defective switch.

c. Shorted or defective wiring.

d. Lamp filament open (burned).

**C20. Position lights fail to burn or fail to go dim with switch in DIM position.**

a. All of item C19 above.

b. Defective dimming resistor.

**C21. Landing lights fail to light when switch is in FWD or BOTH position.**

a. Circuit breaker faulty or out.

b. Defective ldg light switch.
c. Lamp filament broken or burned.
d. Broken or loose wires.
e. Defective landing light relays.

**C22. Landing light circuit breaker out when switch placed to ON position.**

a. Defective switch.
b. Shorted wire in circuit.
c. Excessive ampere demand from lamp (due to incorrect lamp or loose wires).

**C23. Blowers fail to operate when DEFOG & VENT switch is placed to the ON position.**

a. Defective switch.
b. Broken wire.
c. Loose connections.
d. Defective blower motors.

**C24. DEFOG & VENT breaker switch trips to OFF.**

a. Shorted wire.
b. Shorted or faulty blower motors.

**C25. Lack of or no power when external power plug is connected.**

a. Power supply voltage from external source too low. (300-750 min/max Amps.)
b. External power relay inop.
c. Dirty/corroded pins or plug at external power receptacle.
d. Reverse polarity.

**C26. External power relay is energized with reverse polarity voltage applied to external power receptacle.**

a. Defective one-way diode.
b. Improper circuit wiring.

**C27. Anti-collision light(s) burn constantly.**

a. Flasher is not properly grounded.

b. Inop flashers.

**C28. Anti-collision light(s) fail to illuminate.**

a. Broken wire or improper grounding.

b. Dirty or corroded receptacle.

c. Defective switch.

d. Defective circuit breaker.

e. Incorrect light bulb.

f. Defective or improperly wired flasher unit.

**C29. FUEL boost PUMP circuit breaker trips.**

a. Wiring shorted/defective relay.

b. Shorted or defective pump.

**C30. ENG DEICE circuit breaker trips.**

a. Shorted wiring.

b. Faulty deice motor.

**C31. FUEL boost PUMP fails to operate when breaker is closed (in).**

a. Defective breaker in pump circuit.

b. Faulty wiring or loose connections.

c. Defective pump.

d. Fuel boost pump switch in OFF position or defective.

e. System voltage low.

**TROUBLESHOOTING GUIDE D - CAUTION PANEL**

**CONDITION**

**PROBABLE CAUSE**

**D1. All or some caution lights dimly illuminated.**

a. Moisture in connector plug.
b. Poor grounding of light.
c. Caution panel malfunction.
d. Low battery voltage.

**D2. All caution lights out.**

a. Connector plug disconnected.
b. Test switch defective.
c. Broken wires.

**D3. MASTER CAUTION light ON only.**

a. Reset and check again.
b. Wire grounded out (short).
c. Small amount of ferrous resistance in one of the chip detector plugs.
d. Loose wire connection.
e. Caution panel malfunction.

**D4. FUEL BOOST caution light on.**

a. Wire grounded out (short).
b. See items C29 and C31.

**D5. 20 MINute FUEL caution light ON.**

a. Wire grounded out (short).
b. Low fuel supply.
c. Faulty caution panel.
d. Low level switch defective.
e. Defective wiring or connections.

D6. FUEL FILTER caution light ON.

a. Grounded wire (short).

b. Fuel filter is clogging and bypass is imminent.

c. Caution panel malfunction.

d. Faulty filter pressure switch (fuel).

e. Faulty caution light.

D7. ENGine OIL BYPASS caution light ON.

a. Wire grounded out (short).

b. Defective float switch.

c. Caution panel malfunction.

D8. XMSN CHIP DET caution light ON.

a. Wire grounded out (shorted).

b. Faulty wiring or caution panel.

c. Internal failure of gears or bearings.

d. Ferrous chips on plug.

D9. ENGine CHIP detector caution light ON.

a. Wire grounded out (short).

b. Faulty caution panel.

c. Ferrous chips on plugs.

D10. T/R CHIP DET caution light ON.

a. Wire grounded out (short).

b. See item F9.

c. Faulty caution panel.

D11. INSTrument INVERTER caution light ON.

a. Wire grounded out (short).

b. Inverter inop.

c. A/C fail relay inop.

d. Faulty caution panel.

e. See item C12.

**D12. DC GENERATOR caution light ON.**

a. Wire grounded out (short).
b. Generator inop.
c. See items C7 and D16.
d. Faulty caution panel.

**D13. HYDraulic PRESSure caution light ON.**

a. Hyd boost solenoid circuit breaker out.
b. Hyd system turned off.
c. Low hyd pressure because of low fluid.
d. Pressure relief valve inop.
e. Defective Hyd pump.
f. Solenoid valve not operating properly (stuck closed).
g. Electrical wiring to warning light, solenoid valve or pressure switch not correct.
h. Faulty caution panel.
i. Ruptured hydraulic line.

**D14. DC GENERATOR caution light not ON prior to engine start.**

a. Defective bulbs.
b. Defective caution panel circuit.
c. Broken or disconnected wire from generator fail relay.
d. Faulty voltage regulator.

**D15. All or any caution lights on dimly.**

a. Moisture in connector plugs.
b. Shorted dimming circuit system.
c. One bulb burned out.

**D16. DC GENERATOR caution light is on after engine start with switch in GEN position and N1 at idle speed or above.**

a. Ammeter indicates a load.

(1) Defective GEN fail relay.

(2) Shorted wire.

b. Ammeter indicates zero.

(1) Defective generator switch or breaker.

(2) Defective voltage regulator.

(3) Defective generator (output is lower than battery).

(4) Defective ammeter.

(5) Defective line control relay.

**D17. IFF caution light on.**

a. Wire grounded out.

b. Faulty caution panel.

c. Unit not keyed or improper operation used.

**D18. SPARE caution light on.**

a. Wire grounded out (short).

b. Faulty caution panel.

**TROUBLESHOOTING GUIDE E - POWER PLANT**

**CONDITION**

**PROBABLE CAUSE**

**E1. Throttle stiff.**

a. Flexible cable defective.

b. Fuel control malfunction.

c. Control rod binding or chaffing.

d. Foreign object obstructing control movements.

e. Fuel control shaft binding.

**E2. Little or no fuel flow to engine driven fuel pump.**

a. No fuel in cell.

b. Disconnected fuel line.

c. Ruptured or broken fuel line.

d. Defective fuel shutoff valve.

e. Defective boost pump.

f. Air in fuel lines.

**E3. N1 below 62% with throttle at engine idle.**

a. Throttle linkage, bell crank or support loose or broken.

b. Incorrect gas producer fuel control lever setting.

c. Gas producer fuel control idle adjustment incorrectly set.

d. Tachometer malfunction.

e. Air sensing lines leaking.

f. Defective governor.

g. Defective fuel control.

**E4. N1 above 64% with throttle at engine idle.**

a. Incorrect gas producer fuel control lever setting.

b. Gas producer fuel control idle adjustment incorrectly set.

c. Defective fuel control.

**E5. Fuel dripping from drain and weep holes.**

a. Fuel pump drive shaft seal leaking.

b. Gas producer fuel control failure.

c. Fuel nozzle stuck open.

**E6. N2 instability above idle speed.**

a. Faulty double check valve.

b. Air sensing tubes leaking.

c. Faulty N2 governor.

d. Faulty fuel control.

**E7. Linear actuator fails to respond when GOVernor RPM is placed to INCR/DECR switch position.**

a. Defective or open circuit breaker in overhead console.

b. Faulty wiring or loose connection.

c. Switch contacts corroded or burned.

d. Defective linear actuator.

e. Leads connected to wrong terminals on actuator.

f. Governor shaft binding.

**E8. Linear actuator moves in opposite direction to increase/decrease selection.**

Leads connected to wrong terminals on actuator or switch.

**E9. Fluctuating TOT, N1, N2 and torque gage.**

a. Faulty overspeed governor.
b. Faulty fuel control.
c. Engine deterioration.
d. Pneumatic air leak.
e. Faulty or dirty double check valve.
f. Contaminated fuel.

**E10. At full open throttle and full governor increase, N2 RPM not correct (not getting a 7% spread).**

a. Actuator needs adjustment.
b. Governor stops being contacted.
c. N1 or N2 fuel control malfunction.
d. Droop compensator shear tube or control tubes bent.
e. Engine not developing sufficient power.

**E11. Governor RPM too high or low at full open throttle and decrease beep (must have 94%).**

a. Governor stops being contacted.
b. Governor faulty or improperly rigged.
c. Droop compensator improperly rigged.
d. Shear tube weak.

**E12. Excessive time for linear actuator to complete travel.**

a. Defective actuator.
b. N2 governor binding.
c. Control tubes restriction.

**E13. No change in TOT when ENG DEICE switch is turned ON or OFF (increase of 20 degrees will insure proper operation).**

a. Deice circuit breaker out or faulty.

b. Faulty switch or wiring.

c. Defective deice unit.

d. Deice valve not properly rigged.

**E14. Bleed valve is not opening or closing at proper N1 speed.**

a. Jet assembly has not been replaced for the check.

b. Calculation error.

c. Faulty bleed valve unit.

**E15. Compressor stall, fluctuating engine instruments, during start.**

a. Fifth stage bleed valve stuck closed.

b. Dirty compressor.

**E16. Compressor stall, fluctuating engine instruments, during acceleration.**

a. Compressor erosion.

b. Bleed valve stuck closed.

c. Defective gas producer fuel control.

d. Faulty deice valve assembly.

e. Dirty compressor.

**E17. Engine slow to accelerate from engine idle to power.**

a. Loose pneumatic fittings.

b. Dirty or eroded compressor.

c. Defective fuel control or governor.

d. Excessive compressor air leakage.

**E18. Low power with high TOT.**

a. Dirty compressor.

b. Eroded compressor.

c. Anti-icing valve leaking.

d. Compressor FOD.
e. Restriction to compressor air inlet.
f. Fifth stage bleed control valve has failed to close.
g. Heater control valve leaking.
h. Compressor air leaks.
i. Faulty TOT indicator.
j. Faulty torquemeter indicating system.
k. Improperly adjusted TOT resistor spool (8 ohms).

**E19. Low TOT normal or high power.**

a. Faulty TOT indicator.
b. Improperly adjusted resistor spool (8 ohms).
c. Loose thermocouple wire terminal.
d. Faulty TOT thermocouple assembly.
e. Not actually developing power indicated. (N1 or torque system inop.)
f. Improper hardware installed.

**E20. Engine N1 overspeed above maximum limits.**

a. Faulty N1 tachometer.
b. Faulty gas producer fuel control.
c. Pilot induced.
d. Auto acceleration. (Fuel control heater not on for ambient conditions.)

**E21. Engine N2 overspeeds.**

a. Faulty gas producer fuel control or power turbine governor.
b. Faulty N2 tachometer or tachgenerator.

**E22. Continuous exhaust smoking.**

a. Oil leakage in turbine section.
b. Oil bellows seal faulty.

c. Internal turbine seals faulty.

d. Compressor front support bearing oil seal.

**E23. Exhaust smoking on shut down or engine start.**

Turbine rear bearing seal.

**E24. Static oil leakage from drain valve.**

a. External oil check valve.

b. Turbine rear bearing sump nut.

**E25. Number two engine bearing labyrinth seal venting oil vapor.**

a. Diffuser vent orifice loose.

b. Diffuser vent orifice too large.

c. Defective seal.

**E26. Exhaust duct emitting sparks.**

a. FOD in engine.

b. Turbine or compressor blade, vane, or seal damaged.

**E27. Excessive engine vibration.**

a. Bearing or accessories section, internal failure.

b. Compressor or turbine damage.

c. Loose engine mounts.

**E28. Static oil leakage from power and accessory gear box breather.**

a. External oil check valve.

b. Internal check valve failure under the oil filter housing.

**E29. Excessive overshooting of RPM or hunting during collective APPLICATION.**

a. N1 or N2 governors inop or faulty.

b. Improper rigging (droop).

**E30. No heated air from registers or abnormally loose switch (no stops).**

a. Heater switch defective.

b. Temperature selection switch set at lower position.

c. Bleed air line not connected.

d. Defective solenoid on mixing valve or electrical wire not connected.

e. Remote sensor inop or control cable not connected.

f. Defective mixing valve.

**E31. Restricted warm air supply.**

a. Leaks or obstruction in ducts.

b. Mixing valve malfunction.

c. Heater outlet valve incorrectly set.

**E32. Outlet temperature too high or too low.**

a. Temperature selection incorrectly set.

b. Defective remote sensor or mixing valve.

c. OVERTEMP switch defective.

**E33. Torquemeter too high or too low at flat pitch and 100% N2 RPM.**

a. Improper initial pitch change links setting.

b. Torquemeter gage inop.

**E34. Engine oil consumption exceeds 6-1/2 ounces per hour.**

a. Leakage at a loose fitting or connection.

b. Restricted vent lines.

c. Defective internal engine oil seals.

**E35. Unable to move throttle to below engine idle.**

a. Idle release button malfunction.

b. Throttle controls binding.

c. Throttle improperly rigged.

d. N1 fuel control malfunction.

e. Copilot's collective stick not properly installed.

## TROUBLESHOOTING GUIDE F - TRANSMISSION

CONDITION

PROBABLE CAUSE

**F1. XMSN OIL PRESSure light ON, with engine at operational RPM (62% N1).**

a. Wire of XMSN trasmitter is grounded out between transmitter and warning light.

b. Low oil level.

c. Faulty oil pump.

d. Leakage or restriction between pr sure relief valve and transmitter.

e. Pressure relief valve malfunction.

f. Defective transmitter.

**F2. XMSN OIL PRESSure light is not illum ated prior to engine start.**

a. Disconnected connector plug or broke wire from transmitter.

b. Faulty light bulbs.

c. Light bulbs not properly seated in sock

d. Corroded terminals.

**F3. XMSN OIL HOT warning light on.**

a. Wires grounded out from transmitt r to warning light.

b. Shorted transmitter or indicator.

c. Obstructed air flow into transmission oil cooler.

d. Oil cooler clogged or obstructed.

e. Oil cooler bypass valve malfunction.

f. Clogged oil jets.

g. Seized bearing or other internal transmission failure.

h. Low oil quantity.

**F4. Excessive pylon motion.**

a. Loose bearing on isolation mount fitting.

b. Internal deterioration isolation mount.

c. Worn or loose pylon support link bearings.

**F5. Oil leakage around freewheeling unit.**

a. Faulty seals or preformed packing.

b. Faulty valve assembly.

c. Hose leaking.

d. Orifice fitting allowing excessive oil pressure to get to freewheeling assembly.

**F6. Grease leakage at main driveshaft.**

a. Improper assembly.

b. Cut or torn preformed packing.

c. Cut or torn boot.

**F7. Abnormal coupling wear of main driveshaft.**

a. Improper assembly.

b. Incorrect or contaminated lubricant.

**F8. Excessive loss of grease from hanger bearings.**

a. Improper assembly.

b. Bearing misaligned within hanger clamp.

c. Bearing overlubricated.

**F9. Metal chips in tail rotor gear box, electrical chip detector light is on.**

a. Internal failure of gears or bearings.

b. Submit oil sample.

**F10. Autorotation RPM too high or too low.**

a. Blade angle set incorrectly.

b. Gross weight different than computed.

## TROUBLESHOOTING GUIDE G - HYDRAULIC

CONDITION

PROBABLE CAUSE

**G1. Excessive feedback in flight or during power cylinder check, HYD BOOST ON.**

a. Feedback in collective and cyclic.

(1) Air in system.

(2) Excessive out-of-track or out-of-balanced rotor system.

(3) Low pump pressure.

(4) Main pressure relief valve inop.

b. Feedback felt in one flight control.

(1) Loose servo assembly or attaching bolts.

(2) Excessively worn rod end bearings.

(3) Defective servo.

**G2. HYDraulic BOOST control switch ineffective.**

a. HYD system circuit breaker popped or faulty.

b. Faulty switch.

c. Faulty connections or wiring.

d. Faulty solenoid valve.

e. No HYD pressure.

f. Electrical failure.

**G3. Flight controls do not operate smoothly.**

a. Sticking servo control valve.

b. Pivot bolts in input lever are sticking or over-torqued.

c. Low pump pressure.

d. Air in system.

e. Pump one-way check valve improperly installed.

**G4. Servo actuators chatter when moving controls**

a. Air in servo actuators.

b. Low HYD pressure.

c. Loose servo assembly or attaching bolts.

d. Excessively worn rod end bearings.

**G5. Excessive feedback with HYD BOOST OFF.**

a. Excessive out-of-track or out-of-balance of main rotor.

b. Irreversible valve malfunction.

c. Air in irreversible chamber.

d. Pilot valve malfunction.

**G6. During power cylinder check, feedback is felt in cyclic stick.**

a. Servo pilot valve malfunction.

b. Defective servo.

c. Pump malfunction, low pressure.

**G7. Cyclic jams during rapid movement.**

a. Defective servo.

b. Low HYD pressure or fluid level.

c. FOD in flight controls/flight controls binding.

**G8. Collective motors up or down, HYD BOOST ON.**

a. Pilot valve bolts too tight.

b. Defective servo.

**G9. Hydraulic system too hot. (The HYD PRESSure caution light may illuminate.)**

a. Relief valve inop, cracking pressure starts too low.

b. Low fluid level.

c. HYD filters are clogged or starting to clog.

d. One way check valve installed wrong.



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**G10. Unable to get collective up sufficiently (boost on).**

a. Defective servo.

b. Improper rigging or controls jammed.

**TROUBLESHOOTING GUIDE H - FLIGHT CONTROLS**

**CONDITION**

**PROBABLE CAUSE**

**H1. Cyclic binding in certain areas with FORCE TRIM OFF.**

a. Wiring harness binding at base of cyclic stick.

b. Foreign matter in base of stick.

c. Foreign matter under deck.

d. Rough spot in friction device.

e. Rod end bearings worn or dirty.

**H2. With FORCE TRIM OFF, cyclic continues moving after small force applied or moves without cyclic input.**

a. Moves forward or aft only.

(1) Cyclic centering spring improperly adjusted.

(2) Improperly rigged force trim.

b. Moves mostly in a 45 degree angle.

(1) Servo cylinder control head bolts too tight.

(2) Defective servo.

c. Moves with less than 0.5 pounds of force - friction improperly adjusted.

**H3. Pedals binding.**

a. Foreign matter binding forward controls under center console.

b. Rod end bearing malfunction.

c. Control tube binding on phenolic block in tailboom.

d. Excessive friction applied on T/R pedal friction device.

**H4. Excessive play in pedals.**

a. Worn pitch change mechanism.

b. Worn tube rod end bearings or pedal adjustor assembly.

**H5. Unable to increase collective friction using pilot adjustable friction device.**

a. Friction knob jammed.

b. Threads need cleaning.

c. Malfunction in jackshaft friction.

**H6. Collective built-in friction too light or too heavy.**

a. Friction nut/clamp at jackshaft not adjusted properly.

b. Binding of N2 system.

**H7. Collective stick binds and sticks or has break-away force.**

a. Friction device worn or rough, or improperly adjusted.

b. Electrical wire harness at base of collective fouling.

c. Obstruction of push-pull tubes from collective to swashplate.

d. N2 governor or control binding.

e. N2, droop compensator or shear shaft tube binding. Check rod ends.

f. Defective servo.

**H8. Any magnetic brake fails to energize with FORCE TRIM SWITCH in ON position.**

a. Defective magnetic brake.

b. Copilot's cyclic stick connector plug must be connected even with stick in stored position.

**H9. Magnetic brake fails to deenergize when FORCE TRIM switches are depressed.**

a. Defective switch.

b. Wiring is shorted out, grounded.

**H10. Force trim weak or allows play in cyclic.**

a. Improper built-in spring tension adjustment.

b. Improper rigging.

c. Magnetic brake inop.

d. Wrong gradient spring assembly installed.

e. CAP NUT with double safety wire is not properly adjusted.

**H11. Force trim stiff.**

a. Wrong gradient spring installed.

b. Spring tension out of adjustment.

**H12. Excessive friction on cyclic with force trim released.**

a. Adjustable friction not completely off.

b. Foreign matter in base of stick.

c. Magnetic brake unit stiff (dragging).

**H13. Force trim holds in same position with FORCE TRIM switch in OFF position.**

a. Faulty magnetic brake binding.

b. Faulty wiring at switches.

c. Improperly rigged.

**H14. Force trim inoperative.**

a. Faulty switches.

b. Open circuit breaker.

c. Open or shorted wire.

d. Faulty magnetic brake.

e. No electrical power going to magnetic brake (insure copilot cyclic connector plug is connected).

**H15. Unable to get normal cyclic travel.**

a. Improper rigging of cyclic or collective.

b. Control components improperly installed.

c. Force trim improperly rigged.

**H16. Cyclic position abnormal for flight condition.**

a. Cyclic rigged improperly.

b. C.G. not as computed.

**H17. Rotor response to cyclic inputs slow or inconsistent.**

a. Cyclic rigged improperly.

b. Servo leaking.

c. Faulty HYD pump.

d. Faulty pressure relief valve.

**H18. Cyclic stick not centered in stable hover.**

a. Fore and aft C.G. not within limits.

b. Lateral C.G. not within limits.

c. Cyclic rigged improperly.

d. Swashplate improperly rigged.

**H19. Pedal creep.**

a. Dynamic balance.

b. Washer stackup incorrect (see TM 55-1520-228-23).

c. Aircraft not into wind.

**H20. Unable to obtain a minimum of 83% up and/or 17% down during collective (Hyd Boost off) check.**

a. Defective tension torsion straps.

b. Collective binding.

c. Faulty torque system.

d. Maximum power reached prior to 76 psi up.

**H21. VRFC rough or binding.**

a. Control cables have sharp or compound bends.

b. Rough or seizing bearings in idler bellcrank or in swivels at shear link terminals.

**H22. Excessive freeplay or looseness in VRFC.**

a. Loose idler bellcrank attachment.

b. Worn rod end bearings.

c. Shear link terminals are loose or have play.

d. Shear link terminal rod ends have play.

**H23. VRFC System inop.**

a. Broken shear pins or shear link terminals.

b. Electro-Mechanical disconnects inop.

**TROUBLESHOOTING GUIDE I - NOT APPLICABLE**

**TROUBLESHOOTING GUIDE J - VIBRATIONS**

**CONDITION**

**PROBABLE CAUSE**

**NOTE**

**See Section IV, C for detailed information on vibrations.**

**J1. Extreme low frequency vibration (approximately 2 to 3 beats per second).**

a. Loose or faulty isolation mount or mount bearing.

b. Severe maneuvers (i.e. relatively long ground runs with collective up during practice autorotations.

c. Extreme asymmetric (lateral) loading.

d. Low g maneuvers.

e. Low rotor rpm.

**J2. Low frequency vibrations.**

**NOTE**

**Low frequency vibrations are divided into two groups: laterals and verticals.**

a. Laterals.

(1) Spanwise.

a. Blades of unequal weight.

b. Blades of unequal flight time.

c. Blades from different environments.

d. Moisture in blades.

Improper filling/repair techniques.

f. Improper balancing techniques.

g. Trunnion not centered.

(2) Chordwise.

a. Blades of unequal time.

b. Improper balancing techniques.

c. Improper alignment (sweep).

d. Excessive movement (2 flats) of pitch change control tubes.

b. Vertical.

(1) 1/REV (5 to 6 cycles per second, i.e., 354 rpm ÷ 60 sec = 5.9 CPS)

a. Excessively worn parts.

b. Climbing (weak) blade.

c. Weak trim tabs.

d. Improper smoothing procedures.

e. Damaged blades.

(2) 2/REV (10 to 12 cycles per second).

a. Insufficient friction on swashplate uniball.

b. Excessively loose control linkage or swashplate parts.

c. Deteriorated or separated pylon isolation mount; worn transmission to isolation mount attachment bolt or bearing.

d. Excessive degrees of trim tab on one or both blades.

e. Tailboom attachment bolts improperly torqued.

f. Loose blade latch bolt/nut.

**J3. Medium frequency vibration felt in airframe. (20 to 25 cycles per second)**

a. Skids or crosstube loose.

b. Unstowed equipment.
c. Horizontal stabilizer attachment bolts loose.
d. Vertical fin attachment bolts loose.
e. Any loose airframe components.
f. Airframe skin is oil canning.

**J4. High frequency vibration.**

a. Tail rotor hub assembly unbalanced.
b. Worn or loose blade bearing.
c. Loose or shifted trunnion.
d. Loose or worn pitch change link bearing.
e. Bent pitch change link.
f. Loose retaining nut.
g. Loose or worn pitch change slider.
h. Worn tail rotor flapper bumper.
i. 90-degree gear box alignment or failure.
j. Retaining bolts of 90-degree gear box loose.
k. Loose bolts in flexible couplings.
l. Worn splined adapters.
m. Tail rotor driveshaft bent.
n. Shaft hanger bearing rough or failed.
o. Loose hanger bearing housing.
p. Oil cooler fan unbalance or failure.
q. Engine malfunction.
r. Generator bearing failure.
s. Freewheeling unit failure.
t. Engine oil pump failure.
u. Loose engine mounts.
v. Main drive shaft failure.
w. Main transmission malfunction.

x. Hydraulic pump failure.

y. Transmission oil pump failure.

z. Attitude indicator or turn and slip indicator's gyroscope malfunction.

**J5. Excessive torsional oscillation.**

a. Double check valve dirty or inop.

b. Air leak in system.

c. Faulty power turbine governor.

d. Faulty fuel control.

## TROUBLESHOOTING GUIDE K - COMMUNICATION/NAVIGATION EQUIPMENT

| CONDITION | PROBABLE CAUSE |
|---|---|
| **K1. Radios inoperative.** | |
| | a. Circuit breaker out. |
| | b. Headset not plugged in completely. |
| | c. Radios improperly tuned. |
| | d. ICS panel malfunction. |
| | e. Connector plug disconnected or broken. |
| | f. Radio malfunction. |
| | g. Antenna wire disconnected or crossed. |
| **K2. ICS Panel malfunction.** | |
| | a. ICS panel inop. |
| | b. ICS panel disconnected. |
| | c. Headset not plugged in completely. |
| | d. Circuit breaker out. |
| **K3. #1 FM radio inoperative.** | |
| | a. KY-28 dummy plugs not installed. |
| | b. KY-28 not turned on. |
| **K4. ADF malfunction.** | |
| | a. ADF inop. |
| | b. NDB station inop. |
| | c. Loop antenna inop. |
| | d. ADF set not connected. |
| | e. Antennas disconnected. |
| **K5. KY-28 and T-SEC 1/A malfunction.** | |
| | a. Sets are zeroized. |
| | b. Codes not set correctly. |
| | c. Mode position switch incorrectly set. |

d. ARC-114 slave cards are old series.
e Sets not connected properly.
f. Circuit breaker out.

# SECTION IV. SPECIAL PROCEDURES

**General.** This section contains special procedures which were referenced in Section II.

**A. Fuel Control Max Speed Stop.** Refer to TM 55-2840-241-23.

**B. Baseline HIT.**

1. A new baseline HIT will be established if an engine or fuel control is replaced, fuel control max speed stop is adjusted, or any other components or accessories are replaced or adjusted that would affect engine performance.

**NOTE**

**The HIT baseline TOT data should not be established until completion of all other pre-takeoff procedures. This assures that the engine is completely warm and the instruments stabilized.**

2. Follow instructions found on OH-58A HIT TOT Worksheet. Refer to TM 55-2840-241-23.

C. Vibration Analysis.

NOTE

**Step-by-step procedures for solving vibration problems are shown in Section V. Troubleshooting is shown in Section III, J.**

NOTE

**Vibrations as a whole may be identified by category based on their magnitude.**

1. Extreme Low Frequency Vibration: The extreme low frequency vibration occurs at 2 to 3 beats per second and is confined to the pylon area of the helicopter. When severe enough, this vibration is known as spike knock. The vibration may be induced by a test pilot using a slight fore and aft movement of the cyclic (3″ to 4″). Once the movement is made, the cyclic should be centered. At this time the test pilot can count the number of cycles it takes for the vibration to dampen out. Dampening should be completed in 4 to 5 cycles. Even though fore and aft movement is made on the cyclic, the pylon will rock laterally.

2. Low Frequency Vibration.

NOTE

**Low frequency vibrations are divided into two groups: laterals and verticals. All lateral vibrations must be eliminated before a vertical vibration can be eliminated because a lateral will manifest itself as a vertical in forward flight. Lateral vibrations are "RPM" sensitive.**

a. Lateral. Lateral vibrations are caused by an out of balance condition; either spanwise or chordwise.

(1) Spanwise. A spanwise imbalance is due to a weight difference in the spanwise axis of the blades.

(2) Chordwise. A chordwise imbalance condition is caused by the center of gravity of one blade not being compatible with the other blade.

**NOTE**

**Vertical vibrations are divided into two categories: 1/rev (5 to 6 cycles per second) and 2/rev (10 to 12 cycles per second), i.e., 1/rev 354 + 60 = 5.9 CPS 2/rev 5.9 x 2 = 11.8 CPS).**

b. Vertical. Vertical vibrations are caused by one blade developing more lift at a given pitch setting than the other blade develops at the same point.

(1) 1/rev vibration.

(2) 2/rev vibration. The OH-58C as any other two-bladed rotor system has a certain amount of 2/rev vibration that is inherent in the aircraft; thus, we are interested in removing that amount which would be considered excessive. Not only is an excessive amount uncomfortable, but it increases the wear on the components thereby causing them to fail prematurely. Since this vibration occurs at 10-12 CPS, it would be unrealistic to think that you could count the cycles per second.

3. Medium Frequency Vibration. A medium frequency vibration occurs at 20-25 cycles per second and is another inherent vibration associated with most helicopters. An increase in the level of these vibrations is caused by a change in the capability of the fuselage to absorb vibrations or a loose airframe component, such as skids vibrating at that frequency. Changes in the fuselage vibration absorption can be caused by such things as fuel level, external stores, structural damage and repairs, internal

loading, or gross weight. Abnormal vibration levels of this range are most always caused by something loose, either a part of the aircraft, a part of the cargo, or external stores.

4. High Frequency Vibration. Since a high frequency vibration can be caused by anything that rotates or vibrates at tail rotor speed or faster, this includes many unusual situations such as hydraulic lines buzzing or starter relay buzzing, to the most common and obvious cause - tail rotor balance.

## SECTION V. CHARTS AND FORMS

**General.** This section contains the necessary charts and forms required to ascertain that the aircraft is performing to established standards and to record readings, pressures, RPM, etc., obtained during the maintenance test flight.

**List of Charts**


| Figure Number | Title | Page |
|---|---|---|
| 5-1 | OH-58 Ground Tracking Procedure | 5-3 |
| 5-2 | Lateral Smoothing Procedure ..... | 5-5 |
| 5-3 | Vertical Smoothing Procedure .... | 5-7 |
| 5-4 | Balance Weight Conversion..... | 5-9 |
| 5-5 | Maintenance Test Flight Check Sheet..... | 5-11 |

**CAUTION**

**If a problem is encountered during any phase of vibration check, do not continue. Shut down helicopter and correct problem. Repeat each step until no malfunction is detected that cannot be corrected by the next check or adjustment.**

**NOTE**

**Refer to TM 55-1520-228-23 for proper dimensions and maintenance procedures.**

**NOTE**

**The ground track is a reference only and does not mean that the rotor is in the best flight configuration.**

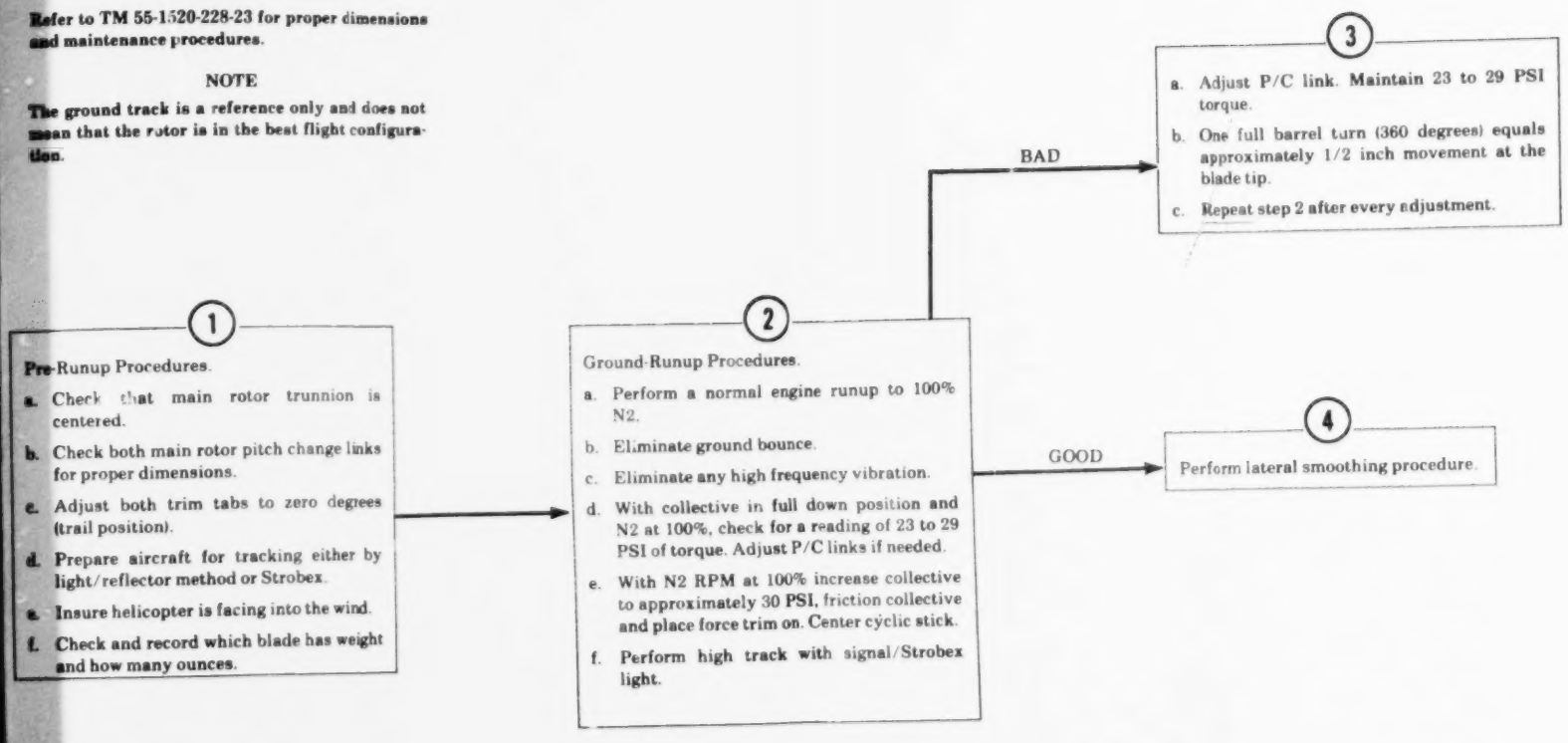
1
Pre-Runup Procedures.
a. Check that main rotor trunnion is centered.
b. Check both main rotor pitch change links for proper dimensions.
c. Adjust both trim tabs to zero degrees (trail position).
d. Prepare aircraft for tracking either by light/reflector method or Strobex.
e. Insure helicopter is facing into the wind.
f. Check and record which blade has weight and how many ounces.
2
Ground-Runup Procedures.
a. Perform a normal engine runup to 100% N2.
b. Eliminate ground bounce.
c. Eliminate any high frequency vibration.
d. With collective in full down position and N2 at 100%, check for a reading of 23 to 29 PSI of torque. Adjust P/C links if needed.
e. With N2 RPM at 100% increase collective to approximately 30 PSI, friction collective and place force trim on. Center cyclic stick.
f. Perform high track with signal/Strobex light.
BAD
3
a. Adjust P/C link. Maintain 23 to 29 PSI torque.
b. One full barrel turn (360 degrees) equals approximately 1/2 inch movement at the blade tip.
c. Repeat step 2 after every adjustment.
GOOD
4
Perform lateral smoothing procedure.

***Figure 5-1. Ground Tracking Procedures***

**NOTE**

**All lateral vibrations must be eliminated before a vertical vibration can be eliminated. A lateral vibration will manifest itself as a vertical vibration in forward flight.**

NOTE

**The following procedures are to be used only if the vibrex balancing kit is not available. The vibrex is the recommended method and it should be utilized.**

**1** In ground effect hover, check for and eliminate any lateral vibration.
- vibration → **2**
- no vibration → **8**

**2** Add weight to one of the blade retaining bolts for spanwise balance.
- worse → **3**
- better → **4**

**3** Remove weight and place in other blade. Repeat step ①

**4** Continue adding weight until the vibration level is reduced to the MAXIMUM SPANWISE balance.
- vibration → **5**
- no vibration → **8**

**5** If vibration is still detected, sweep one blade aft 1/2 point and recheck at an I.G.E. hover.
- worse → **6**
- better → **7**

**6** Remove sweep and put the same amount in the other blade. Repeat step ⑤

**7** Continue using aft sweep until MAXIMUM CORDWISE balance is obtained.
- no vibration → **8**

**NOTE**

**If more than 1 point of adjustment was needed, return to step ① and recheck for a MAXIMUM SPANWISE balance.**

**CAUTION**

**Maximum aft movement must not exceed 3 points of the latch bolt nut.**

**CAUTION**

**Insure safe forced landing area is within reach at all times during O.G.E. hover.**

**8**

a. Perform O.G.E. hover at 100% N2.
- vibration → **9**
- no vibration → **11**

**NOTE**

**O.G.E. hover should be performed between 1500 and 2000 feet AGL.**

**NOTE**

**O.G.E. hover not required when using Vibrex balancing kit.**

b. If vibration is detected, add 1/2 unit of weight until MAXIMUM SPANWISE balance is obtained.

c. Eliminate all lateral 1:1 vibration.

**9** If MAXIMUM SPANWISE balance has been obtained during O.G.E. hover and vibration is still detected, sweep one blade aft 1/2 point until MAXIMUM CORDWISE balance is obtained.
- unacceptable → **10**
- acceptable → **11**

**10** If vibration is unacceptable, remove M/R hub and check for:

(1) Blade alignment.

(2) Trunnion centered and rotational breakaway force.

(3) Hub and blade balanced.

(4) Recheck friction on swashplate uniball.

(5) Return to step ① figure 5-2.

**11** If vibration level is acceptable and all 1:1 laterals are eliminated, go to figure 5-3 and solve vertical vibration problems.

*Figure 5-2. Lateral Smoothing Procedures*

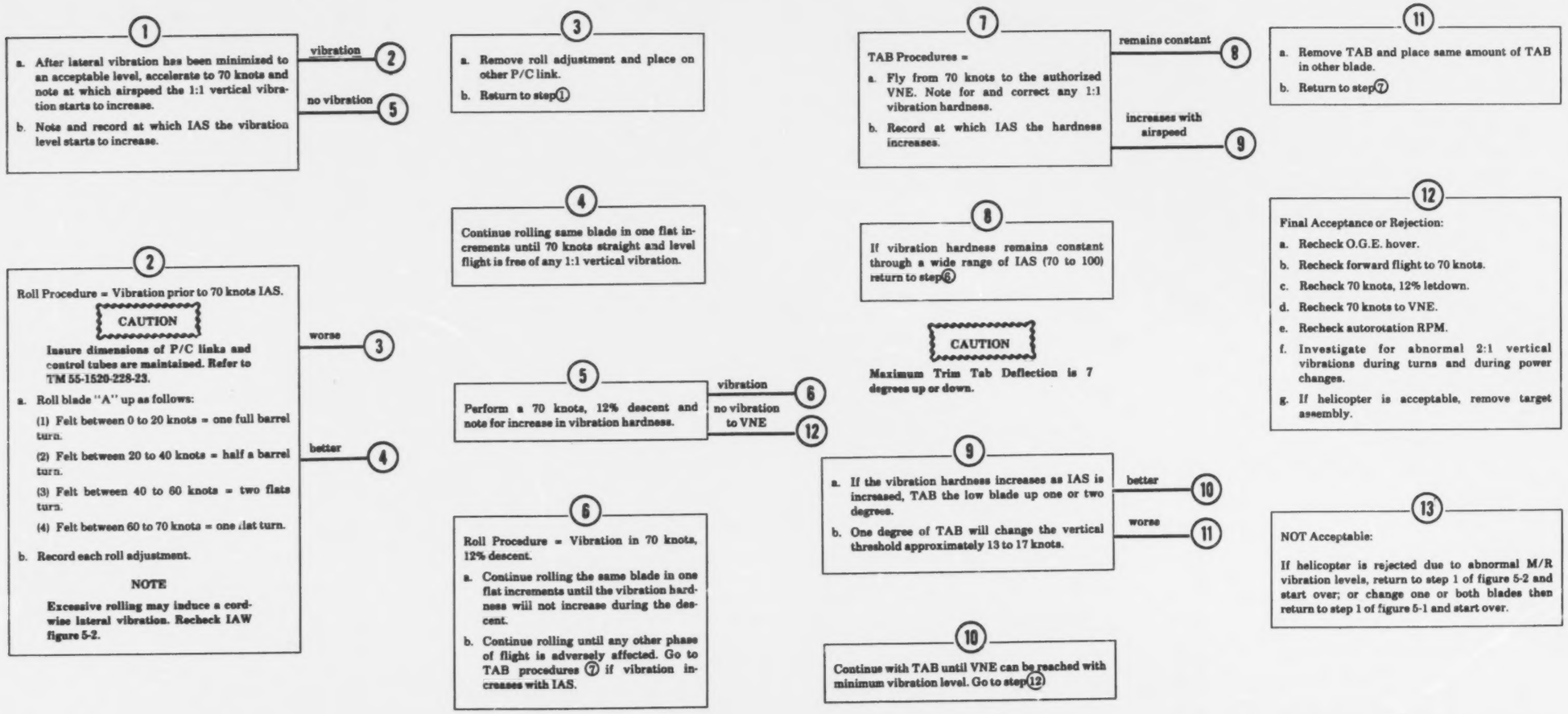
1
a. After lateral vibration has been minimized to an acceptable level, accelerate to 70 knots and note at which airspeed the 1:1 vertical vibration starts to increase.
b. Note and record at which IAS the vibration level starts to increase.
vibration
2
no vibration
5
2
Roll Procedure = Vibration prior to 70 knots IAS.
CAUTION
Insure dimensions of P/C links and control tubes are maintained. Refer to TM 55-1520-228-23.
a. Roll blade "A" up as follows:
(1) Felt between 0 to 20 knots = one full barrel turn.
(2) Felt between 20 to 40 knots = half a barrel turn.
(3) Felt between 40 to 60 knots = two flats turn.
(4) Felt between 60 to 70 knots = one flat turn.
b. Record each roll adjustment.
NOTE
Excessive rolling may induce a cordwise lateral vibration. Recheck IAW figure 5-2.
worse
3
better
4
3
a. Remove roll adjustment and place on other P/C link.
b. Return to step 1
4
Continue rolling same blade in one flat increments until 70 knots straight and level flight is free of any 1:1 vertical vibration.
5
Perform a 70 knots, 12% descent and note for increase in vibration hardness.
vibration
6
no vibration to VNE
12
6
Roll Procedure = Vibration in 70 knots, 12% descent.
a. Continue rolling the same blade in one flat increments until the vibration hardness will not increase during the descent.
b. Continue rolling until any other phase of flight is adversely affected. Go to TAB procedures 7 if vibration increases with IAS.
7
TAB Procedures =
a. Fly from 70 knots to the authorized VNE. Note for and correct any 1:1 vibration hardness.
b. Record at which IAS the hardness increases.
remains constant
8
increases with airspeed
9
8
If vibration hardness remains constant through a wide range of IAS (70 to 100) return to step 6
CAUTION
Maximum Trim Tab Deflection is 7 degrees up or down.
9
a. If the vibration hardness increases as IAS is increased, TAB the low blade up one or two degrees.
b. One degree of TAB will change the vertical threshold approximately 13 to 17 knots.
better
10
worse
11
10
Continue with TAB until VNE can be reached with minimum vibration level. Go to step 12
11
a. Remove TAB and place same amount of TAB in other blade.
b. Return to step 7
12
Final Acceptance or Rejection:
a. Recheck O.G.E. hover.
b. Recheck forward flight to 70 knots.
c. Recheck 70 knots, 12% letdown.
d. Recheck 70 knots to VNE.
e. Recheck autorotation RPM.
f. Investigate for abnormal 2:1 vertical vibrations during turns and during power changes.
g. If helicopter is acceptable, remove target assembly.
13
NOT Acceptable:
If helicopter is rejected due to abnormal M/R vibration levels, return to step 1 of figure 5-2 and start over; or change one or both blades then return to step 1 of figure 5-1 and start over.

*Figure 5-3. Vertical Smoothing Procedures*

| ITEM NO. | NOMENCLATURE | WEIGHT | ARM | UNBALANCE |
|---|---|---|---|---|
| 1. | Masking Tape, one inch wide. | | | |
| | a. Two inch length | 0.18 gm | 30 inch | 5.4 in/gm |
| | b. Four inch length | 0.36 gm | 30 inch | 10.8 in/gm |
| | c. Six inch length | 0.54 gm | 30 inch | 16.2 in/gm |
| 2. | AN3-4A bolt | 3.41 gm | 1.25 inch | 4.4 in/gm |
| 3. | AN3-5A bolt | 3.86 gm | 1.25 inch | 4.8 in/gm |
| 4. | AN3-6A bolt | 4.26 gm | 1.25 inch | 5.3 in/gm |
| 5. | AN3-7A bolt | 4.72 gm | 1.25 inch | 5.9 in/gm |
| 6. | NAS679A3 nut | 1.27 gm | 1.25 inch | 1.6 in/gm |
| 7. | AN960-10 washer | 0.9 gm | 1.25 inch | 1.1 in/gm |
| 8. | AN970-3 washer | 5.0 gm | 1.25 inch | 6.2 in/gm |

*Figure 5-4. Balance Weight Conversion*

OH-58C MTF CHECKSHEET

| | |
|---|---|
| **PURPOSE OF TEST FLIGHT:** | **ACFT S/N:** **DATE:** |
| **PILOT:** | **UNIT:** |
| **SYMBOLS:** √ = **SATISFACTORY** | X = **DEFICIENCY** |

| | |
|---|---|
| **PRIOR TO MAINTENANCE TEST FLIGHT** | 6. ENGINE RESPONSE |
| 1. FORMS AND RECORDS | **INFLIGHT CHECKS** |
| 2. FLIGHT READINESS INSPECTION | 1. CONTROL RIGGING |
| **BEFORE STARTING ENGINE CHECKS** | 2. AUTOROTATION |
| 1. FAT _____ °C | ROTOR _____ RPM |
| 2. ALTIMETER | 3. ENGINE PERFORMANCE |
| 3. WARNING LIGHTS | CHECK |
| 4. CAUTION PANEL | PA _____ FAT _____ |
| **STARTING ENGINE AND RUNUP CHECKS** | TORQUE _____ N1 _____ |
| 1. START | TOT _____ |
| PEAK TOT _____ °C | 4. HYDRAULIC OFF |
| START TIME _____ | UP _____ PSI |
| 2. CYCLIC | DOWN _____ PSI |
| 3. COLLECTIVE | 5. VIBRATION ANALYSIS |
| 4. HYDRAULIC SYSTEM | 6. FLIGHT INSTRUMENTS |
| 5. ENGINE IDLE SPEED CHECK | AIRSPEED _____ MAG COMP _____ |
| 6. GOV RPM SWITCH | IVSI _____ RBI _____ |
| 7. COMPRESSOR BLEED VALVE | ATT IND _____ CLOCK _____ |
| START CLOSE _____ %N1 | TURN & SLIP _____ |
| FULL CLOSED _____ %N1 | 7. AVIONICS |
| 8. TORSIONAL OSCILLATION | XPDR _____ VHF _____ |
| 9. FUEL PUMP | ADF _____ UHF _____ |
| 10. ENGINE DE-ICE | FM #1 _____ KY-28 _____ |
| 11. INSTRUMENTS | FM #2 _____ T-SEC 1/A _____ |
| ENG OIL PRESS _____ PSI | **ENGINE SHUTDOWN CHECKS** |
| ENG OIL TEMP _____ °C | 1. BATTERY |
| TORQUE _____ PSI | 2. INSTRUMENTS |
| TOT _____ °C | ENG OIL PRES _____ PSI |
| N1 _____ % | ENG OIL TEMP _____ °C |
| 12. HIT | TORQUE _____ PSI |
| **AIRCRAFT HOVER CHECKS** | TOT _____ °C |
| 1. HOVER POWER | N1 _____ % |
| TORQUE _____ PSI | 3. POST TEST FLIGHT INSP |
| TOT _____ °C | 4. COMPLETE UPDATE FORMS & RECORDS |
| N1 _____ % | 5. SPECIAL EQUIPMENT LIST |
| 2. FLIGHT CONTROLS | 1. |
| 3. PYLON ISOLATION MOUNT | 2. |
| 4. PRIMARY DIRECTIONAL CONTROL | 3. |
| 5. POWER CYLINDER | 4. |

*Figure 5-5. Maintenance Test Flight Check Sheet (Sheet 1 of 2)*

ROTOR SMOOTHING RECORD

| RED BLADE SERIAL NUMBER | | | | | WHITE BLADE SERIAL NUMBER | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ADJUSTMENT NUMBER | TAB | ROLL | BALANCE | EFFECT | ADJUSTMENT NUMBER | TAB | ROLL | BALANCE | EFFECT |
| 1 | | | | | 1 | | | | |
| 2 | | | | | 2 | | | | |
| 3 | | | | | 3 | | | | |
| 4 | | | | | 4 | | | | |
| 5 | | | | | 5 | | | | |

REMARKS

PILOT'S SIGNATURE

*Figure 5-5. Maintenance Test Flight Check Sheet (Sheet 2 of 2)*

## The Metric System and Equivalents

### *Linear Measure*

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

### *Weights*

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigrams = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

### *Liquid Measure*

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

* U.S. GPO : 1989 O - 235-196

PIN: 051139100